MACHINERY.

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THE CLEVELAND CITY FORGE AND IRON COMPANY.

J. V. STANFORD.

The plant of the Cleveland City Forge and Iron Company is equipped exclusively for the manufacture of light and heavy forgings of iron and steel. This plant is located on a spur of the Lake Shore and Michigan Southern Railroad, with all facilities for shipping—one building of wooden construction containing the three departments, forge, machine shop and smith shop.

The processes involved in the manufacture of heavy hammer forgings, particularly of iron, are of great interest and little known. The fluid compression process has partly replaced hammer forgings for some purposes, notably for large shafting, solid and hollow; but the hammer is still used for this purpose, and will always be used for work of irregular shape, such as shown in Figs. 1, 2 and 3. Material for iron forgings is purchased in the form of wrought-iron scrap and old car axles. This material is sheared into small pieces and "piled" on thin boards, as shown in Fig. 4. The piles are carried to the forge rooms and placed in a furnace until brought to a welding heat.

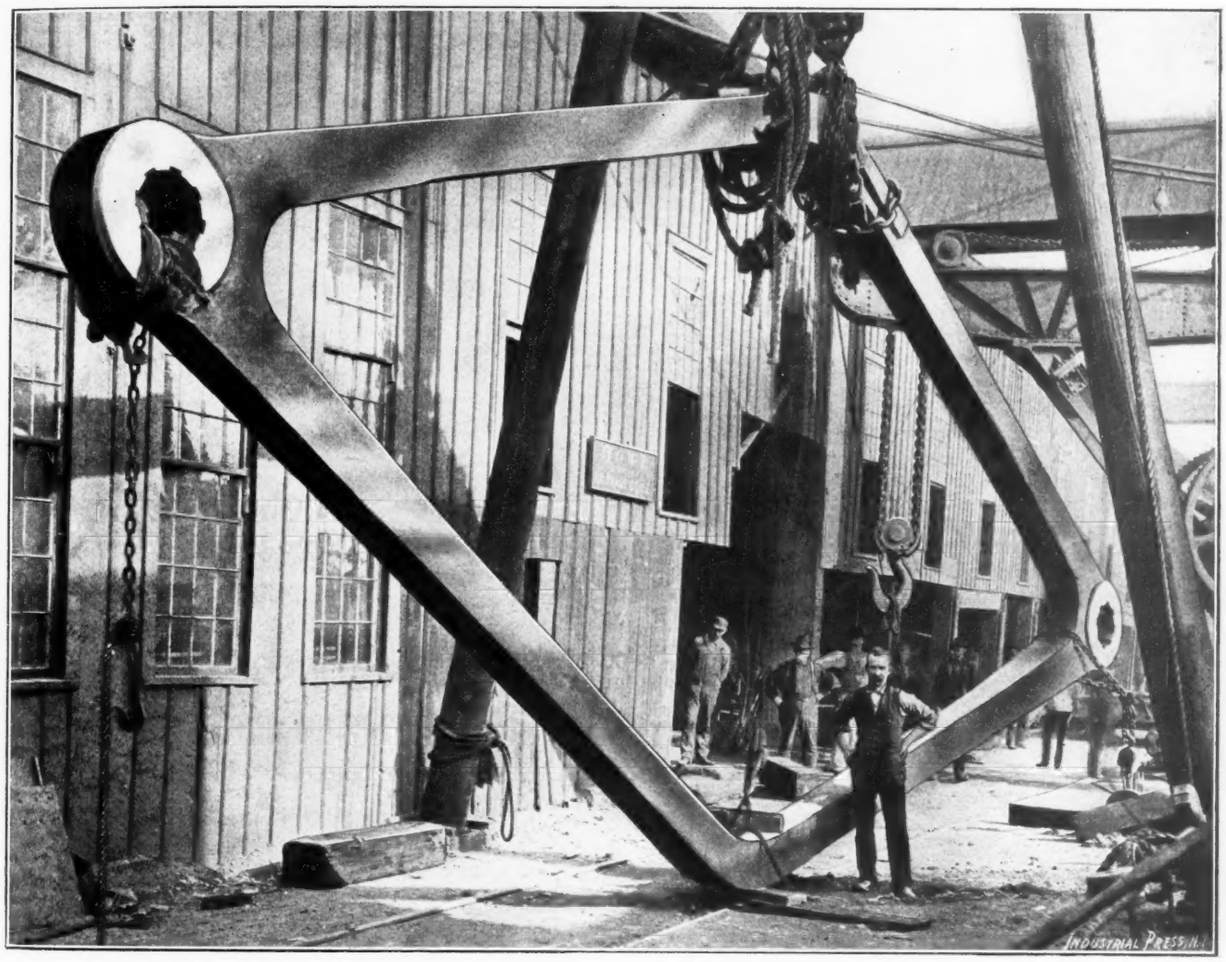


Fig. 1. Beam Strap for the Steamer Puritan, forged and finished by the Clevelard City Forge & Iron Co. Finished weight, 36,310 Pounds.

The general arrangement of the forge room may be seen from Fig. 5. Along one side is a long row of hammers served by jib cranes; heating furnaces are along the other, and there is an industrial railway between. The heating furnaces are of the ordinary reverberatory type, waste gases being utilized in boilers to generate steam for the hammers. These hammers, seen in Fig. 5, are 5-ton helve hammers. The heavy helve and cast-iron head are raised by a steam piston located near the trunnions, and drop under the action of gravity. That part of the helve which extends back of the trunnions is made to strike a heavy hickory timber, acting as a spring to give additional impetus to the drop for a heavy blow. In addition to these hammers there is a 15-ton steam hammer, Fig. 6, used on the largest work. At the time this hammer was built it ranked second in size in the world, but it no longer holds that place. Steam acts both to raise the head, and to deliver the blow. The large jib crane which serves this hammer has handled forgings weighing 60 tons.

The pile of sheared scrap, having reached a welding heat in the furnace, is removed to one of the hammers, which welds it into a rectangular bar, technically called a "shingle slab," and at the same time drives out the slag. These slabs form the basis for all iron forgings and, as they are seen piled in stock, indicate very plainly their origin, traces of bolts, nuts, horseshoes and the whole stock in trade of the old metal man being discernible. In fact, it is claimed that by etching the surface of finished forgings with acid, faint outlines of the original scrap shapes may be seen.

In building up a large forging from slabs, the nucleus is

the "porter bar," a cylindrical forging with one end flattened out in the form of a shovel. Sixteen shingle slabs are piled onto this flattened portion, the whole is balanced on a crane chain, and the end carrying the slabs swung into a furnace. Fig. 7 shows a porter bar in position in the furnace, also the "stocks," which are clamped onto the outer end, to furnish a hold for the men who balance the bar, and rotate it under the hammer. Welding heat being reached, the bar is carried to the hammer, the slab pile is welded, part of it forged to the required shape, and the rest flattened out into shovel form to receive more slabs, when the process is repeated. The forging grows slowly with each addition of slabs and in this way shafts 28 inches in diameter and 40 feet long have been built up.

When finished the forging is cut from the porter bar and is ready for the machine shop. The dimensions and form of work under the hammer are checked by means of long-handled fixed calipers and sheet iron templets. Many ingenious methods are employed for building up irregular shapes by this process. The forging of a crankshaft with one or more central cranks will serve to illustrate. First, a square bar of the proper length and of sectional area equal to that of the round part of the shaft is built up. At the points where the cranks are located, slabs are piled, heated, welded and trimmed to shape, and then the remainder of the shaft is rounded up. This leaves the crank throws solid, and the excess metal is machined out. This process results in a very tough and reliable forging, its structure consisting of a mass of interlacing fibers, as determined by the first piling of the scrap, thoroughly worked and compacted by the hammer.

Work as large and complicated as the steamer parts shown in Figs. 1 and 3 is forged in sections as large as may be conveniently handled at the hammer, rough machined, and welded together. This welding is done in the smith shop. Scarf joints are machined in the parts to be welded, which are laid out in their proper relative positions and clamped. Portable fires placed over the joints produce the welding heat, the clamps being gradually tightened as the metal softens until dimensions are correct. The weld is completed by hand hammering, and trimmed.

The problem presented when a steel forging is required is altogether different, no building up or welding being possible. A mass of steel large enough for the finished forging must be used from the start and hammered into shape. Stock for steel forgings is bought, in the form of 4-inch billets for small work, and in octagon ingots, sometimes weighing 70 tons, for large work.

Practically everything produced in the forge goes through the machine shop to be rough machined or finished to size, as specified. The hammer man leaves a heavy finish all over the forgings, some of which, on account of difficulty in hammering to shape, approximate only very roughly the finished piece, necessitating the removal of a large amount of metal by machine. As an instance of this, a large steel crank, consisting of two webs and a pin, weighed 61,600 pounds upon leaving the hammer, being practically a solid block, and 10,200 pounds when finished. The machine shop is provided with heavy tools for this work, two of the largest being shown in Figs. 8 and 9. Fig. 9 shows a planer, 10 feet by 12 through the housings, with a 25-foot bed, at work splining an engine shaft. The lathe in Fig. 8 swings 6 feet over a 60-foot bed and takes the largest work produced in the forge. Fig. 8 also shows the method of serving the tools, work being brought from the forge shop on the industrial railway and swung into position by jib cranes.

The largest and most difficult forgings produced are those required in the construction of steam vessels, main shafts and the parts shown in Figs. 1, 2 and 3. Fig. 1 shows the beam strap that was shrunk onto the cast iron walking beam of the steamer "Puritan" of the Fall River Line. It is 34 feet between end centers, 10¾ x 11⅜ inches section, and weighed when finished 36,310 pounds.

The stern frame in Fig. 2, which supports the outboard bearing for the propeller shaft and the rudder, is 29 feet 8⅝ inches high, 19 feet 5½ inches in extreme width and weighed 27,045 pounds.

Fig. 3 shows the rudder frame that was forged for the battleship "Alabama"; its finished weight was 32,390 pounds.

* * *

An unusual method was used in raising the wreck of the bark Arthur, which foundered in Boston Deeps, Lincolnshire, during the heavy gales of the present winter. The decks and the inner structure of the ship were removed, leaving only the frame and sides, and during high water a steamer was floated over the wreck and allowed to subside inside the hull, the wreck was then made secure to the deck of the steamer, and upon the following tide was lifted off the bottom and towed to a higher portion of the shore, where the work of breaking up could be carried on at low water.—Marine Engineering.

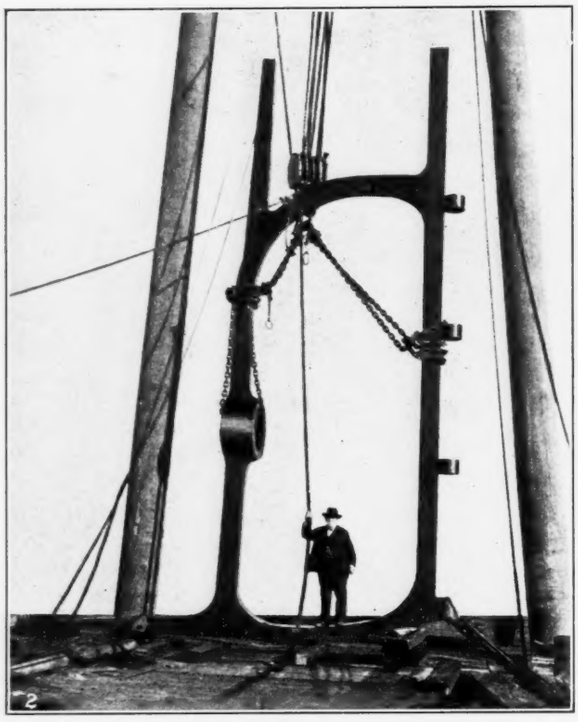


Fig. 2. Large Wrought Iron Frame, forged at the Cleveland City Forge. Weight, 27,045 pounds.

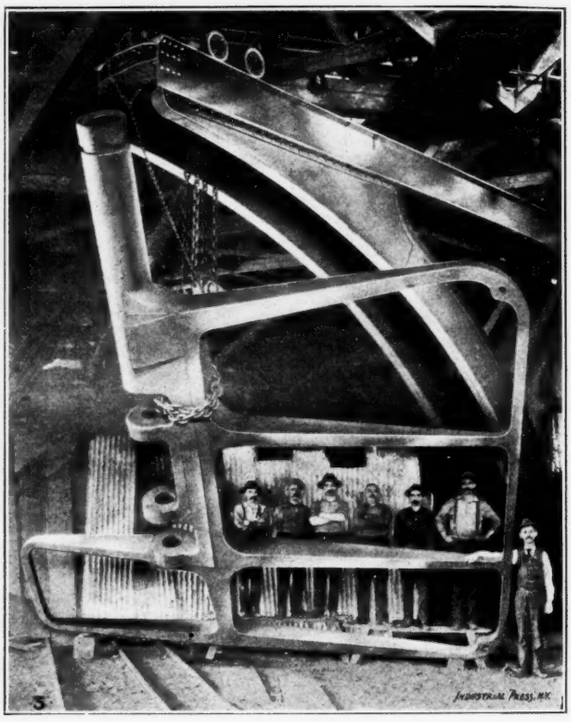


Fig. 3. Rudder Frame for Battleship "Alabama." Weight, 32,390 pounds.

LARGE WATER POWER PLANTS.

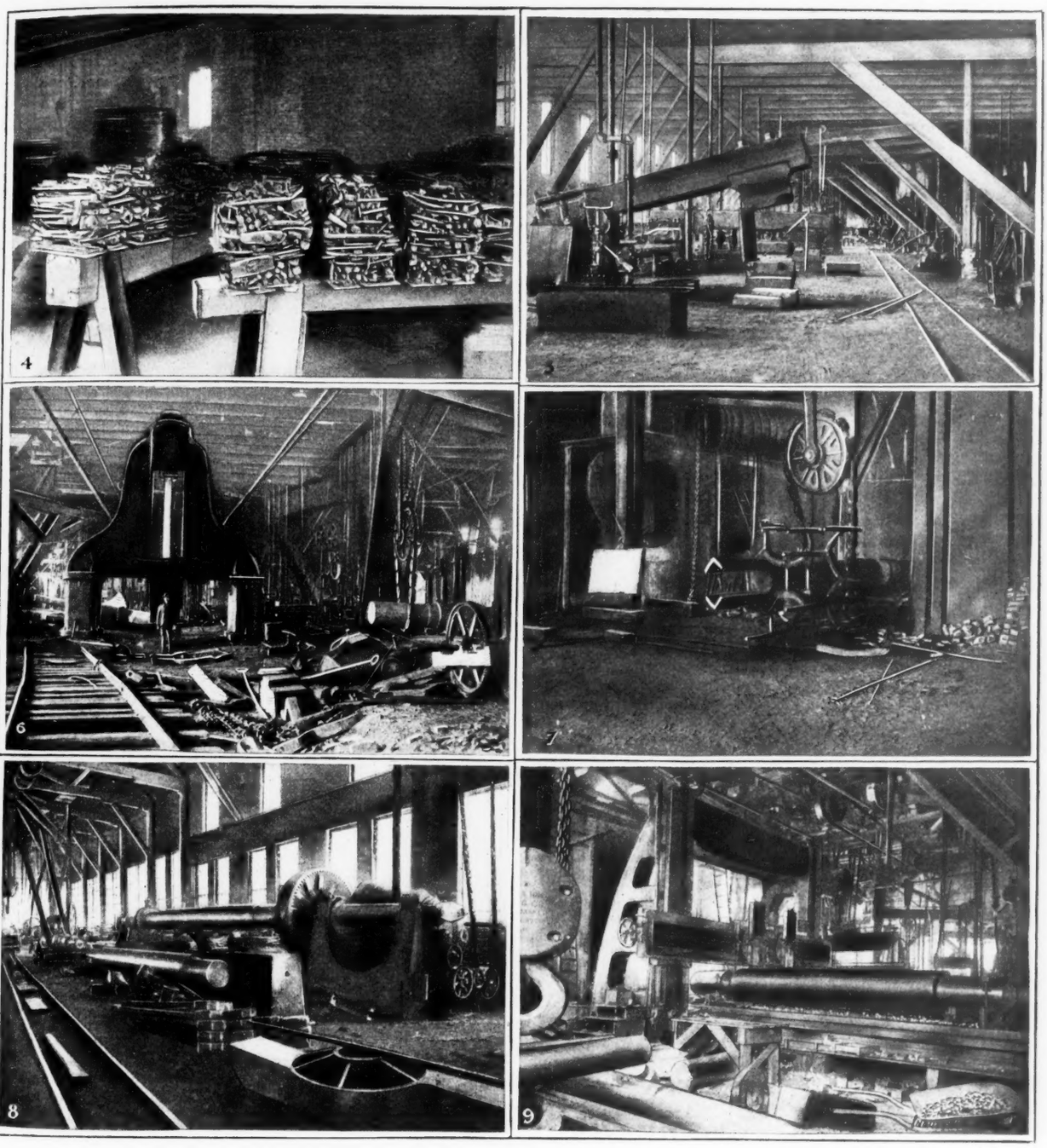
DATA CONCERNING IMPORTANT PLANTS NOW ERECTED OR BUILDING.

There has been no more remarkable development during the past 10 years than in the utilization of water power for generating the electric current for long-distance transmission. In the May number of *Power* is a summary of the important features of the largest American plants of this character, which have recently been built or are now building. The following data are taken from this summary:

The Niagara Falls Power Company, Niagara Falls, N. Y. At power house No. 1 there are 10 twin turbines of 5,000 horse-power each; 10 alternators of 5,000 horse-power each, two-phase, 2,200 volts, 25 cycles, 250 revolutions per minute. Power house No. 2 will contain 11 similar units. The current is transmitted to Buffalo, Tonawanda and Lockport by three overhead transmission circuits, each about 22 miles long. Thirty thousand horse-power is distributed locally.

The Canadian Niagara Power Company, above Horseshoe Falls, Niagara. Works now in process of construction. Designed for a capacity of 100,000 horse-power (net). A pit is to be built for five units of 10,000 horse-power each and to install three units developing 30,000 horse-power net. The turbines are to have a capacity of 12,500 horse-power each. Power will be transmitted according to the demand to neighboring cities and towns, also to local factories.

In the plant at Snoqualmie Falls, Wash., there are four generators of 1,500 K. W. each, the current being of 1,000 volts, 60 cycles. Two transmission lines run parallel 19 miles to Renton and then branch to Seattle—a total distance of 31 miles—and to Tacoma—45 miles.



VIEWS FROM THE CLEVELAND CITY FORGE AND IRON CO.

Fig. 4. Wrought-iron Scrap Sheared into Small Pieces and "piled" up for use in making Iron Forgings.
Fig. 5. Forge Room, showing Five-ton Hammers used for Forging and the Industrial Railway for the Transportation of Materials.
Fig. 6. Fifteen-ton Steam Hammer used on very Large Work.
Fig. 7. Porter Bar shown in Position in the Furnace.
Fig. 8. Lathe for the Largest Work produced in the Forge. It has a Swing of six feet over a Sixty-foot Bed.
Fig. 9. Large Planer at Work Splining an Engine Shaft.

The Bay Counties Power Company, Colgate, Yuba County, Cal., obtains its power from the Yuba River. The company has three power houses with an aggregate capacity of 15,640 horse-power and the possible development is 55,000 horse-power. There are nine high potential lines, going to Sacramento, Nevada City, Oakland, San Jose and other cities.

At the Power Development Company, San Francisco, Cal., water is taken from the Kern River and led through a tunnel 8,484 feet. The flow of water is 300 cubic feet per second. The installation consists of three wheels, one to each generator. Each wheel develops 750 horse-power. The generators are 450 K. W., of 600 horse-power each. The current is transmitted to Bakersfield.

The Mt. Whitney Power Company, Tulare County, Cal., has a power house containing three water wheels, of 700 horse-power each; three generators of 450 K. W. Water is had from the Kaweah River. The current is transmitted to Tulare, Visalia and other towns.

The plant of the Sierra Power Company, North Ontario, Cal., and that of the San Gabriel Electric Company, are run in parallel, although 25 miles apart. The Sierra Power Company have installed two 300 K. W. two-phase generators and two water wheels of the impulse type. Current is carried 25 miles to Azusa, where it joins the San Gabriel current. In the San Gabriel plant there are four water wheels, each unit of 550 horse-power being really two wheels on a single shaft. The current with that from the parallel plant of the Sierra Power Company is transmitted to Los Angeles.

The Pike's Peak Power Company, near Victor, Colo., is a typical California power plant. Here West and Middle Beaver Creeks are made use of by a dam, steel faced, granite back filled, 375 feet long on top, 220 feet long on base, 72 feet high, giving a capacity for 150 days' continuous operation at full station load. From here is a wood pipe 22,400 feet long, built of redwood staves, bound with steel. This is continued by a steel pipe 2,900 feet long. There are four 400 K. W., three-phase, generators driven by two impulse wheels each, directly connected with generators, running 450 revolutions under 505 pounds pressure. The current is sent to Victor, 8½ miles, at 12,600 volts, and from there is distributed to various mining towns. A peculiar feature of this installation is, that owing to the character of the country and the impossibility of erecting poles during the first 3,400 feet from the power house, four granite ridges serve as supports and one span here is 1,120 feet.

The Utah Light and Power Company, near Salt Lake City, has a plant consisting of four double-nozzle wheels 61 inches in diameter, 600 horse-power, 300 R. P. M., which furnish the power to drive four three-phase 400 K. W. generators. Current is generated at a pressure of 500 volts and raised to 10,500 volts for transmission. Circuits transmit current to Salt Lake City, 14 miles, and also to Murray. This company has also a plant at Ogden, Utah, of five impulse wheels direct-connected to five three-phase generators developing 1,000 horse-power each. Pressure is raised to 16,100 volts and transmitted by two circuits to Salt Lake City, where it is distributed from sub-stations at 2,300 volts.

The Walla Walla Gas and Electric Company, of Walla Walla, have a pipe line of wooden staves 5,600 feet long from Mill Creek to their power house. A McCormack turbine is connected by a friction clutch to a 300 K. W. monocycle generator. Current is transmitted a distance of 5 miles.

The Quebec Railway, Light and Power Company has obtained, at Montmorency Falls, a working head of 180 feet, and a cotton mill uses the water afterwards under a head of 60 feet. The present installation comprises 5 turbines of 800 horse-power each; four two-phase generators yielding 5,500 volts at 286 revolutions; one two-phase double current generator yielding direct current from one side at 550 volts and alternating current from the other at 400 volts.

The St. Lawrence Power Company, Massena, N. Y., has an effective head of water, varying from 32 to 40 feet. Seven 5,000 horse-power units are installed, and the company expect to put in 8 more. These yield 2,200 volts, 3,000 cycles.

The Hamilton Electric Light and Cataract Power Company, in Ontario, has two 2,000 K. W. generators direct connected to Italian turbines running at 286 R. P. M.; and two 1,000 K. W. generators direct connected to American turbines which run at 400 R. P. M. Current is transmitted to Hamilton, Ont., a distance of 35 miles.

The Shawinigan Water Power Company has constructed a canal 1,000 feet long from which water is conducted to the power house 130 feet below by six penstocks. The power house contains six units of 5,000 horse-power each. The generators are two-phase and the water wheels have a capacity of 6,000 horse-power each. Current is transmitted to Quebec, a distance of 90 miles, and to Montreal, 84 miles, at a voltage of 40,000.

The West Kootenay Power and Light Company, Ltd., obtains a head of water, varying from 34 to 42 feet, and has installed two turbines of 1,250 horse-power each, and one turbine of 1,800 horse power; also 2 three-phase generators of 1,000 horse-power each. The current is transmitted to Nelson, 10 miles, and a projected line will carry 60,000 horse-power from Bonnington to Rossland.

The Twin City Rapid Transit Company, at Minneapolis, utilizes a fall of 20 feet in the Mississippi and has an available horse-power of from 3,000 to 8,000. The installation consists of four horizontal turbines, eight 1,000 horse-power alternating generators and two 1,000 horse-power continuous current generators. Continuous current is used for the nearby portions of the railway system and the alternating current goes to Minneapolis sub stations and to St. Paul, 6.6 miles away.

The Kalamazoo Valley Electric Company, has built in the Kalamazoo River a dam 29 feet high and obtains a head of 24 feet with a flow of from 90,000 to 100,000 cubic feet per minute. Four pairs of 45-inch horizontal wheels, having a total of 2,800 horse-power and a generator of 1,500 K. W. capacity, comprise the equipment of this plant. Current is transmitted to Kalamazoo, 22 miles, and thence to Battle Creek, a total distance of 46 miles.

At Great Falls, Mont., the Great Falls Water Power and Townsite Company has an available head of 40 feet, from which is developed about 20,000 horse-power. The present installation consists of two pairs of 22½-inch Victor register turbines and one pair of 18-inch Victor cylinder turbines, a number of generators and three M. D. 50-light series arc dynamos. Current is transmitted to the center of the city 2½ miles.

The Hudson River Transmission Company, at Mechanicsville, N. Y., has a head of water of 18 feet and there are 14 pairs of 42-inch turbines, each consisting of two pairs of wheels. At 114 R. P. M. the total power of each set of turbines is 1,000 horse-power. There are also two sets of 18-inch wheels. Seven 1,000 horse-power generators and two 150 horse-power exciters complete the outfit. The current goes to Schenectady, 19 miles, also to Watervliet, 12 miles, and to Albany, 18 miles.

At Canon Ferry, on the Missouri River, the Missouri River Power Company has installed a plant of 10 alternating current units, each consisting of a pair of 42-inch turbines, and one 750 K. W. alternator; six units, each consisting of a pair of 45-inch turbines and one 750 K. W. alternator. Current is transmitted to Helena, Mont., 18 miles; to East Helena, 11½ miles, and to Butte, 65 miles.

Interesting plants have also been installed at Oregon City, on the Willamette River, Oregon, where 12,800 horse-power is developed by a fall of 40 feet and transmitted 14 miles at 5,000 volts; and at Redlands, Cal., 1,600 horse-power. Richmond, Va., has a plant of 11,000 horse-power; the Racquette River, at Hannawa Falls, N. Y., yields 1,250 horse-power. At Big Hole River, Montana, 4,000 horse power is obtained; on Jordan River, Utah, 2,800 horse-power is the yield, and at Delta, Pa., 500 horse-power is obtained from a small creek 5 miles distant. Another California plant is on the Santa Ana River, in the San Bernardino Mountains, from which 3,000 kilowatts are sent 83 miles at 33,000 volts to Los Angeles.

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A company has been organized in Arizona for the unique purpose of mining ice. For some time it has been known that extensive caves existed in Arizona which contain great quantities of ice. Recent explorations have shown that the supply is practically inexhaustible, and it is for the purpose of procuring the cave ice to supply the local market that the company alluded to has been organized.

SOME FEATURES OF ROLLING MILL AND ENGINE DESIGN.

The development of the metallurgical industries in the United States, especially the manufacture of steel, is not less remarkable in many ways than that of the rolling mills and engines and other machinery used in its manufacture. We hear comparatively little about the latter, however, although every one knows, who knows anything about it, that improved rolling mill machinery is largely what has put the

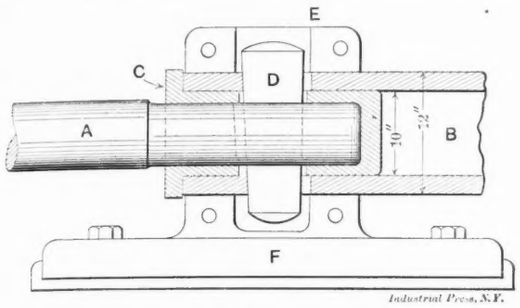

Fig. 1.

United States in its present important position in the iron and steel-making business. The success of at least one great steel manufacturer is largely attributed to his being a great "scrapper" of old machinery. Under his administration rolling mills and engines costing thousands of dollars were yearly relegated to the scrap-pile in favor of new ones of improved and heavier design. This policy is unquestionably a correct one from a business standpoint and is being religiously followed by all the principal steel mills to-day.

A mechanical engineer of Pittsburg, whose name is associated with the design of the rolling mill machinery of many of the principal steel mills at and in the vicinity of that famous center of industry, is Julian Kennedy. During a trip to the Smoky City something less than a year ago the writer had the pleasure of a personal interview with this gifted engineer and was shown some of the original schemes developed by him and incorporated in the designs of different machines. His work is undoubtedly characterized by great strength, simplicity and originality.

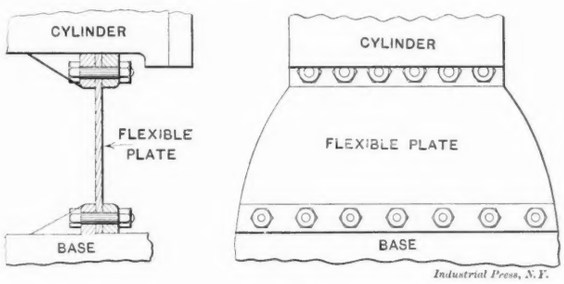

Fig. 2.

In Fig. 1 is shown an ingenious and effective method of uniting the high and low-pressure piston rods of a tandem compound rolling mill engine. This scheme was used on a 42-inch by 72-inch by 60-inch engine built for the Cambria Steel Co. The low pressure piston rod is 14 feet long and 14 inches in diameter with a 10-inch hole through the center. The engine was designed so that the low-pressure piston is carried free of the cylinder, there being a clearance all around of ¼-inch. The great weight of the piston and the length of the piston rod required it to be at least of the diameter given, otherwise there would have been considerable deflection at the center. As it is, the deflection is only about 1-100 inch in 14 feet. To connect the high-pressure piston rod to the low-pressure rod having a 10-inch hole, was something of a problem. The way it was done is shown in the cut. *A* is the high-pressure rod and *B* is the low-pressure rod. A cup-shaped piece *C*, familiarly referred to as a "stove-pipe hat," was designed to fit the internal diameter of *B* and to fit over the end of piston-rod *A*. The piece *B* has a flange abutting against the end of the low-pressure rod. A key-way is cut through *C* and both piston-rods so that the draft of the key *D* draws the parts solidly together. This construction avoids a shoulder on the high pressure piston rod and the consequent liability to fracture. The low-pressure rod is supported at this point between the two cylinders by the slipper *F*. The slipper is made so as to be clamped around the low-pressure rod as indicated at *E*.

In large horizontal engines it is necessary to make provision for expansion and contraction of the cylinders on the bed. The ordinary method is to mount the rear end of the cylinder on a pedestal or slide so that it is free to move longitudinally. A tandem cylinder connected in this manner would be without attachment to the foundation at all since both the front and rear ends would have to be free to move. In the engine for the Cambria Steel Co. the high-pressure cylinder is mounted on a flexible connection at each end which consists of thin steel plates, perhaps ½ or ⅝-inch thick, bolted to the base and to flanges cast on the cylinder,

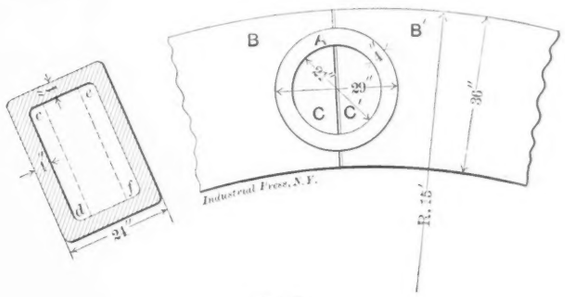

Fig 3.

as indicated in Fig. 2. This construction allows the cylinder to expand freely and at the same time holds it rigidly to the base.

The same engine has a fly-wheel 30 feet in diameter and weighing 100 tons. The rim is rectangular in section and hollow. Its depth is 36 inches and width 24 inches. The walls are 4 inches thick. The rim is built of sections, held together by steel rings shrunk in place on each side, as indicated in Fig. 3. Where these rings set into the rim, the walls are reinforced so that the thickness of metal is uniform throughout. The reinforcement is indicated by the dotted lines *cd* and *ef* in the sectional cut. In this wheel the steel ring *A* is 21 inches internal diameter and 29 inches external diameter, the depth of the section being 4 inches; the thick-

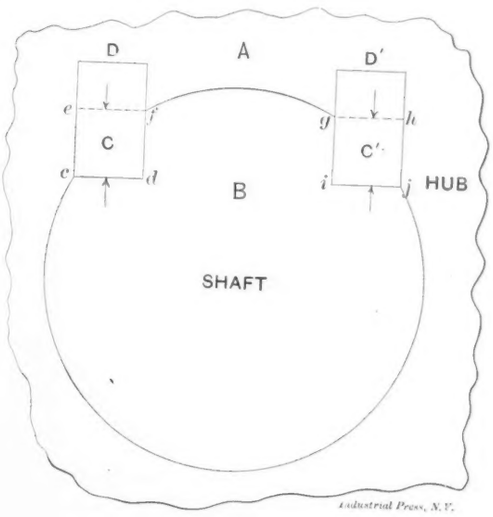

Fig. 4

ness is 3½ inches. This construction is used to some extent in European practice, but we believe not extensively. Its obvious advantage over the ordinary form of shrunk link is that the seat is readily machined, being circular in form. A cutter set in a boring bar with the segments *B* and *B'* in proper relative position is used to bore out the annular seat. The shrinkage allowance can be very accurately made, which is usually not the case with the ordinary shrunk link. In this case the shrinkage allowance was about 1-64 inch. The

limiting feature of the ring form of link is the depth of the rim. It is obvious that the ring must be of sufficient diameter to inclose large enough sections *C C'* to have shearing strength about equal to the tensile strength of the ring. Therefore, it cannot be used advantageously on shallow rims.

The shock of reversal of rolling mill engines having such heavy fly-wheels is something tremendous. Where wheels are keyed with the ordinary form of key and keyway, it is necessary that the bore of the hub fit the shaft closely and that the key fit closely in the keyway. To remove a 30-ton steel gear from its shaft when fitted in this manner, is, of course, a job of considerable difficulty, but the worst feature of it is that such construction does not well stand the shocks of reversing and when once loosened, the key must be renewed. Fig. 4 shows a method of keying fly-wheels and gears to their shafts, which was developed by Mr. Kennedy. The Kennedy system employs two tapered keys *C C'* of approximately square section set with their diagonals radially. The shaft *B* is fitted comparatively loosely in the hub *A*, so that when the keys are removed, the wheel or gear is free to be removed. The keys are fitted so the reaction due to their wedging action is in the direction of the arrows. The faces *ef*, *cd*, *gh*, and *ij* are, therefore, the ones in compression. One

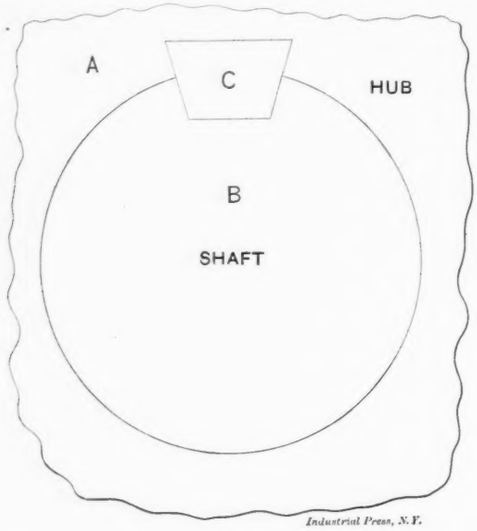

Fig. 5.

key drives in one direction and the other in the opposite direction. Driving in either key tightens both. In the ordinary form of key, the metal composing it is subjected to shearing stress; in this form it is always in compression. The keys are usually made with heads *D D'* for convenience in removal.

Fig. 5 illustrates the method of setting a feather for a wheel or gear working on a splined shaft. The feather *C* has its sides radial with the shaft *B* instead of the time-honored square form commonly used in machine construction. A little reflection will demonstrate that the metal of the shaft is better able to resist shearing stress at right angles to the sides of the feather *C* than if it was of the ordinary form. Another decided advantage is that *C* is fitted in *A* in a manner that prevents its readily becoming loose, and if it does become loose, it cannot turn in the keyway without shearing off a substantial corner. It is also apparent that it is much easier to get a tight permanent fit with the dove-tail construction than with the other form. If the feather ever does work loose a shim placed in the bottom of the slot and the feather driven in on top of it makes it as good as new.

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The minimum expense of keeping a battle-ship in commission is estimated by Admiral Melville to be not less than $1,000 a day. The actual cost of our completed fighting vessels, and the total estimated cost of those building, will probably teach $275,000,000. This is said to represent but half of the expenditure incurred in creating a navy, however, the numerous auxiliaries, training schools, dock yards, coaling stations, etc., swelling the grand total.

BELT DRIVE FOR SHAFTS AT RIGHT ANGLES.

GRAPHICAL METHOD OF LAYING OUT A REVERSIBLE, THREE-PULLEY DRIVE.

FORREST R. JONES.

It frequently occurs in practice that power is to be transmitted by belting between two horizontal shafts at right angles to each other, one near the ceiling and the other near the floor of a room; or, what amounts to the same thing, so far as the belting is concerned, to transmit power between a horizontal and a vertical shaft at some distance apart. The general statement of the case is for a belt drive to connect any two shafts at right angles to each other, but some considerable distance apart. A method that is very commonly practised is to use two pulleys, one upon each shaft, and so set that the belt will run correctly for rotation *in one direction* with either pulley acting as the driver, without the addition of any idle, guide, or binder pulleys. With such an arrangement the reversal of the rotation to even a small extent will throw the belt from the pulleys on account of the manner in which it is put on, and not depending upon whether there is any power transmitted or not. This inability to run in both directions is, in itself, often a very serious fault with a belt drive, for it prevents rotating the shafting backward, which is frequently desirable in many cases. In addition to this there is another fault which becomes very great when the pulleys are large in diameter, and the belt wide, in proportion to the distance between the shafts. This fault, well known to those who have to deal with belting, is a rapid wearing out of the belt on account of the side bend that it must make at the point of leaving each pulley. This side bend stretches the edge of the belt, of course, and almost invariably makes it crooked, and consequently short-lived on account of the excessive stretching. This stretching is all at the same edge when the same side of the belt, as the hair side, runs against both pulleys. And, furthermore, when the pulleys are large in diameter and the belt is wide in comparison with the distance between the pulley centers, a new belt will not run upon the pulleys when they are located in the positions that would be correct for a narrow belt upon the same pulleys. The stiffness of the belt is accountable for this. The wider the belt and the stiffer it is, the more must the pulleys be set out of what may be called their true position when a new belt is first put in place. As the belt stretches upon the edge and becomes more flexible, the pulleys have to be gradually moved back toward their true positions, but do not reach these positions until the belt is nearly worn out, if they ever reach them at all. Of course, by using pulleys very much wider than the belt—say half again as wide, or double the width—the necessity of adjusting them along their shafts might be obviated by setting them so that the belt will run near one side of the face when new, and gradually work over toward the other side as it becomes worn. Few engineers, however, would care to exhibit such a belt drive in an establishment where they are responsible for this branch of the plant.

In order to have a drive in which the belt will give its longest life, it is necessary that the arrangements of pulleys be such that rotation can take place in either direction and have the belt still remain in its correct position. This can be done by introducing a third pulley as an idle or guide pulley, so placed as to act upon one stretch of the belt between the pulleys upon the driving and driven shafts. This may be done, as shown in Fig. 1, which is an isometric drawing representing two shafts, the one, *A*, near the ceiling of a room and the other, *B*, near the floor. The upper one, *A*, is perpendicular to the end wall of the building, and the lower one, *B*, parallel to both the end wall and the floor. Instead of the actual belt in place upon these pulleys, a string is shown corresponding to its center line. If the pulleys are placed so that this string will run properly upon them, then the belt will also keep in place. Further, if an amount of crowning is given the pulleys in proportion to the belt width, there will be no appreciable uneven stretching of the edges of the belt. The twist of the belt between any pair of pulleys should not greatly exceed a quarter turn for a length six or seven times as great as the width of the belt. This means

that the belt should not have a width greater than one-sixth of the distance between *A* and *B*, which distance is equal to the length of the stretch of the belt between them.

In Fig. 1 the pulley on *A* and that on *B* are so placed that one stretch of belt, represented by its center line or by the string, is vertical between them. In other words, the point of tangency of the string with the upper pulley is directly over its point of tangency with the lower one. In order to make clear just how the idle pulley must be located, it may be well to set forth the conditions that must be necessarily fulfilled in order that the belt shall run in either direction upon the pulleys. This condition is that each stretch of belt running off from any pulley must have its center line perpendicular to the axis of that pulley. Another way of expressing this is, that the center lines of the two stretches of belt leading from a pulley must lie in a plane passed through the middle of the pulley and which is, of course, perpendicular to the pulley axis and to the axis of the shaft which supports it. This is called the median plane of the pulley.

The problem which presents itself, therefore, is to locate this idle pulley so that its median plane shall contain the center lines of the belt stretches leading from it. This can be done in practice by setting lines corresponding to the center lines of the two stretches of belt leading to the idle pulley, and then locating a third line corresponding to the axis of the idler which shall be perpendicular to the plane of the two center lines just mentioned. This assumes that the main shafting, or at least the building, has been erected. As is common to all construction work, however, it is often necessary to determine the location of shafting and pulleys before the building is erected, and to send out such drawings as will enable the millwright to get out the necessary timber, supports, etc., before any shafting is in place. The manner in which the drawings can be made, therefore, will be given first, and then the method which may be followed for locating the shafting and pulleys.

In Fig. 2 three views of the main pulleys and their shafts are shown by the method in common use for making drawings of machinery, buildings, etc. The top view in Fig. 2 corresponds to a projection upon the floor in Fig. 1; the side view corresponds to the projection upon the side wall of the building (not shown in Fig. 1), and the end view of Fig. 2 corresponds to the projection upon the end wall in Fig. 1. The co-ordinate axes *XY* and *Y'Z* are shown in Fig. 2 intersecting at *O*. In the top view both pulleys are represented by heavy-line rectangles and the axes of their shafts by dash-and-dot lines; in the side view the pulley *A* is represented by the heavy-line rectangle *As*, and *B* by the circle whose center is at *Bs;* and in the end view *A* is represented by a circle with center at *Ae*, while *B* is represented by a heavy-line rectangle whose center *Be* is on the same horizontal line as *Bs*. It is absolutely necessary that the distance of the center of the pulley *Ah* from the co-ordinate axis *XY*, in the top view, shall be equal to the distance in the end view of the center *Ae* of the large pulley from the co-ordinate axis *Y'Z*. The same is true of the center of the pulley *B*, in that in the top view, the distance from the center of the pulley *Bh* to the co-ordinate axis *XY* must be the same as the distance, in the end view, of *Be* from the co-ordinate axis *Y'Z*. It is not necessary to have the rectangular projections of these pulleys appear in the drawings, as far as the actual solution of the problem is concerned, but they have been shown here in order to bring out their positions more distinctly. The problem can be solved by only the projections of the median planes of the pulleys. This is really the better way, since it obviates the confusion of an unnecessary number of lines.

In Fig. 2 the light lines drawn through the middles of the rectangular projections of the pulleys represent the projections of the median plane of the pulleys and also, in part, the projections of the center lines of the various stretches of belt. No further reference will be made to the heavy lines of these rectangular projections of the pulleys.

The binder pulley may, of course, be placed at any height throughout a considerable range between the upper and lower pulleys. In this case it will be taken as midway between the two. The directions which the center lines of the stretches of belts leading to the idle pulley must follow may be determined by assuming, first, that the idle pulley is to have no sensible diameter, but is only an infinitely small pin or pulley on which the center line of the belt runs. Referring to the side view, the two stretches of belt running from the upper pulley *As* will have both center lines in the median plane of the pulley *As* down as far as the point where this imaginary small idle pulley is located. Under the assumption which has just been made, this point will be midway between *As* and *Bs*, which is at the point *Ms*. From *Ms* the stretches of belt run to the two sides of the pulley *Bs*, the one stretch continuing vertically downward, and the

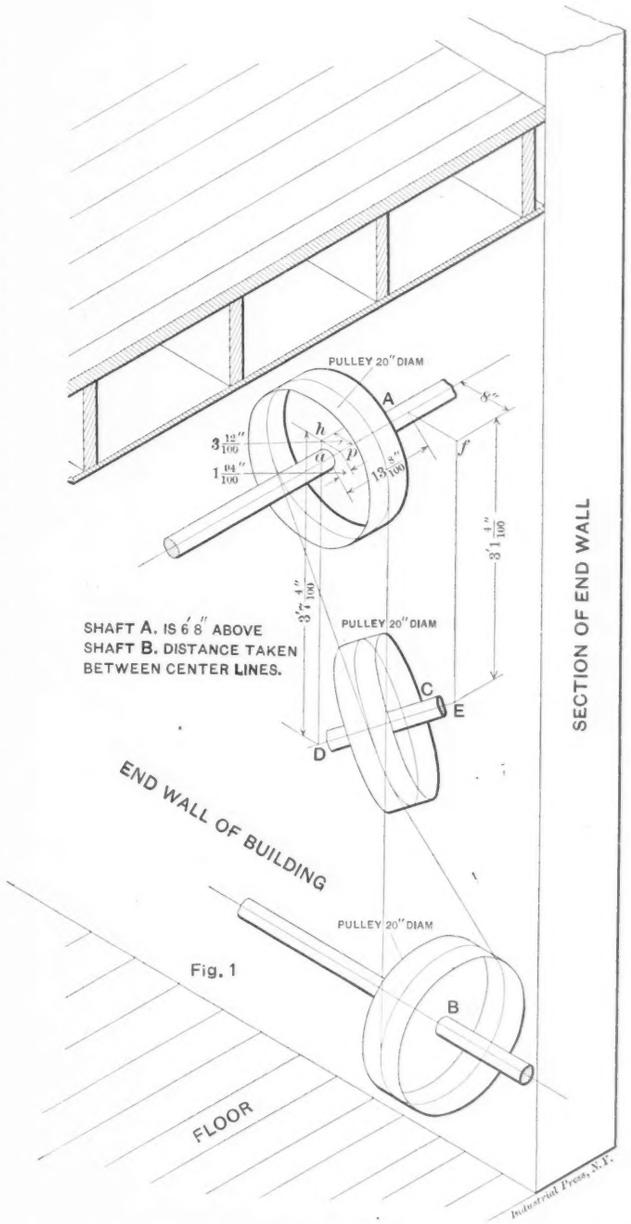

Fig. 1

Fig. 1. Showing two Shafts, one near the Ceiling of a Room and the other near the Floor, with Location for Intermediate Shaft for Idler.

other at an angle with the vertical to the point of tangency *a* with the pulley *Bs*. Draw *Ms-a*, extending it to intersect *Y'Z* at *b*. The projection of *Ms* in the end view will lie at *Me* where a horizontal line through *Ms* intersects the projection of the median plane of *Be* in the end view.

Draw *bF* perpendicular to *Y'Z* and intersecting the median plane of *Be* at *F*. Through *Me* draw a line tangent to *Ae* at *v*, extending it to meet *Y'Z* at *f*; *v-Me* is the projection of the center line of the stretch of belt between *v* and the imaginary small idle pulley at *Me*. Through *F* draw *FY* parallel to *vf*. From *Me* draw *Me-j* perpendicular to *vf* and of indefinite length, intersecting *FY* at *P*. On *vf* take the

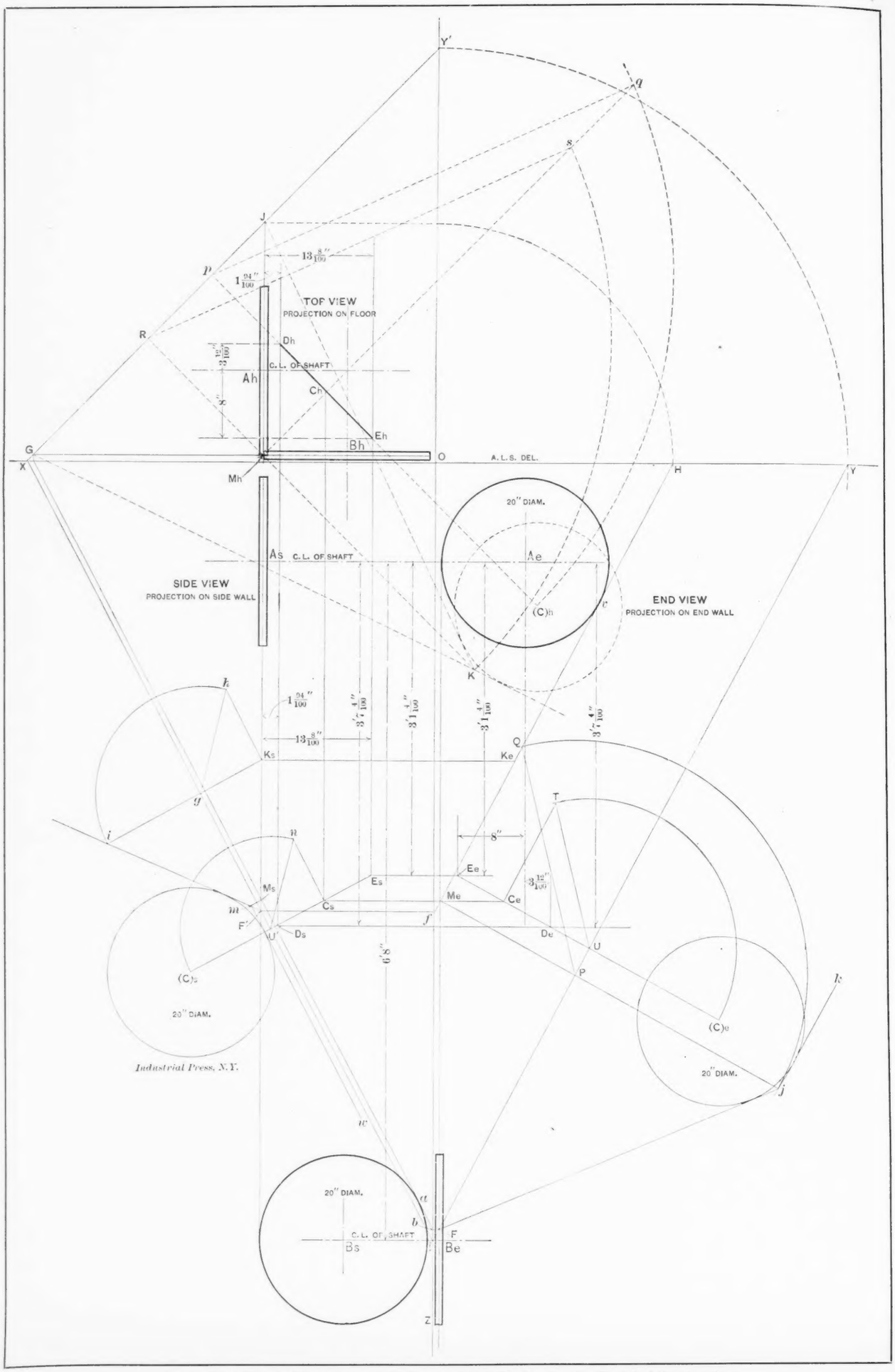

Fig 2. Three Views of Arrangement of Pulleys and their Shafts, showing Graphical Construction.

distance *Me-Q* equal to the distance of *Ms* from *Y'Z*, and with *P* as a center and radius *PQ*, cut off the distance *Pj* equal to *PQ* on *Me-j*. Join *F* and *j*; also draw *jk* parallel to *vf*. The size of the idle pulley may not be assumed. Its radius will be taken as 10 inches, which is the same as that of the main pulleys. With this assumed radius of the idle pulley, find the center (*C*)*e* and draw a circle about it tangent to the two lines *jF* and *jK*. Through (*C*)*e* draw a line perpendicular to *vf* and intersecting *FY* at *U*. Draw *UT* parallel to *PQ*, and with *U* as a center and radius *U*-(*C*)*e*, strike the arc cutting *UT* at *T*. Through *T* draw a line parallel to *vf* intersecting *Ce* (*C*)*e* at *Ce*. The point *Ce* thus determined is the projection of the center of the actual idle pulley of the assumed radius upon the end plane.

A similar construction may now be followed for finding the projection of the center of the idle pulley upon the side plane. Through the point *l* where the line *YF* intersects *Y'Z*, draw a line parallel to *b-Ms*, intersecting *XY* at *X*. At any convenient point on *lX* (as *g*) draw a perpendicular to *lX* intersecting the median plane of *As* at *Ks* and also extending indefinitely on the opposite side of *lX*. Through *Ks* draw a horizontal line intersecting *vf* at *Ke*; also draw through *Ks* a line parallel to *lX* and take upon it a length *Ks-h* equal to the distance of *Ke* from the co-ordinate axis *Y'Z*. With *g* as a center and a radius *gh*, cut off the distance *gi* upon the line *g-Ks*. Through *f* draw a horizontal line intersecting *lX* at *F'*. Join *F'i*. Through *Ms* draw a perpendicular to *a-Ms* intersecting *F'i* at *m*. Through *m* draw *mw* parallel to *lX*. With a radius equal to that assumed for the idle pulley, find a center (*C*)*s* about which a circle tangent to the lines *mi* and *mw* can be drawn. Through (*C*)*s* draw a perpendicular to *lg* intersecting the latter at *U'*. Through *U'* draw a line *U'n* parallel to *gh* and of indefinite length. With *U'* as a center and radius *U'*-(*C*)*s*, strike the arc cutting *U'n* at *n*. Through *n* draw a line parallel to *lg* intersecting (*C*)*s-U'* at *Cs*, thus obtaining *Cs* as the projection of the center of the idle pulley upon the side plane.

The two projections of the center of the idle pulley at *Cs* and *Ce* upon the side and end planes are all that are really necessary for determining the location of a point upon the axis of the idle pulley, with regard to the upper shaft for erecting the belt drive. It is well, however, to check the work by also determining the position of the center of the idle pulley in the top view. This will be done.

In the side view extend the belt line *a-Ms* to intersect *XY*, and from this point of intersection draw a vertical to *XY*, cutting the middle line or median plane of *Bh* at *G*. In the end view extend the center line of the belt *fv* to intersect *XY* at *H*; then, on the middle line of the pulley *Ah*, take the point *J* at a distance from *XY* equal to *Oh*. Draw a line through *G* and *J*, extending it to cut both *XY* and *Y'Z*. The distance *OY'* should equal *OY*; also *JG* should intersect *XY* where *lg* in the side view intersects it. Through the intersection of the middle lines of *Ah* and *Bh* at *Mh* draw a line perpendicular to *JG*, intersecting *JG* at *R* and of indefinite length on the opposite side of *Mh*. Draw another line through *Mh* parallel to *JG* and take on it a length *Mh-S* equal to the distance of *Ms* from *XY*. With *R* as a center and a radius *Rs* cut off the distance *RK* upon *R-Mh*. Join *J* and *K*; also draw *GK*, extending it beyond *K*. Now find the center (*C*)*h* of a circle having a radius equal to that assumed for the idle pulley and which is tangent to the lines *JK* and *GK*. Through (*C*)*h* draw a line perpendicular to *JG*, intersecting the latter at *p*. Through *p* draw a line *pq* parallel to *RS* and of indefinite length. With *p*-(*C*)*h* as a radius and *p* as a center, draw an arc cutting *pq* at *q*. Through *q* draw a line parallel to *JG* intersecting *p*-(*C*)*h* at *Ch*. *Ch* is the horizontal projection of the center of the idle pulley. In this particular case, *Ch* lies upon the line through *Mh* parallel to *JG*. This is not generally true; here it is due to the fact that the main pulleys *A* and *B* are of the same diameter, and the idler is taken midway between them. As a check upon the work, *Ch* and *Cs* should both lie on the same perpendicular to *XY*; also *Ch* should be at a distance from *XY* equal to that of *Ce* from *Y'Z*. Each of the three projections of the idle pulley would appear as an ellipse in Fig. 2. These projections are omitted to prevent confusion of lines and points.

The axis of the idle pulley can now be drawn in its three projections. Since the axis contains the center of the pulley it must pass through the projections of the center in each view. In the top view the axis passes through *Ch* and is perpendicular to *JG*. It therefore lies on the line *p*-(*C*)*h*. In the side view the axis passes through *Cs* and is perpendicular to *lg* and to *a-Ms*. In the end view it passes through *Ce* and is perpendicular to *vf*.

A couple of points *D* and *E* may now be selected at any convenient positions in the axis of the idle pulley, and their locations with regard to the upper shaft *A* determined. The projections of these points are shown at *Dh* and *Eh* in the top view; at *Ds* and *Es*, in the side view; and at *De* and *Ee* in the end view. It may be seen that the distances of these two points in the different directions from the upper shaft *A* are given to one-hundredths of an inch. It is, of course, hardly possible to make measurements of this kind upon a drawing so accurately as this might indicate, even if it is made with the greatest care, as was this one, by the use of steel instruments throughout, including a steel straightedge against which the T-square head rested. These measurements are given, however, as representing the distances as nearly as they could apparently be measured.

It may be seen in Fig. 2 that the point *D* is 3 feet 7.04 inches below the axis of the shaft *A;* 1.94 inch to the right of the median plane of the pulley *A*; and 3.12 inches back of the axis of the shaft *A*. Likewise, the point *E* is 3 feet 1.04 inch below the center line of the shaft *A*; 13.08 inches to the right of the median plane of the pulley *A*; and 8 inches in front of the center line of the shaft *A*. These are the distances that are taken from Fig. 2 and transferred to Fig. 1.

It is often desirable to set all of the bearings for the shafting in the building before any of the shafting itself is in place. A method of doing this which can be applied to the case in hand will therefore be given. It is assumed, of course, that the building has been erected far enough for the supports of the main lines of shafting to be attached to it. Stretch strings in the positions that the center lines of the shafts *A* and *B* are to occupy, and find the point, on the center line of *A*, which is directly over the center line of *B*. This can be done, of course, by the use of a plumb-line. From this point measure backward toward the right, along the center line of *A*, a distance equal to the radius of the pulley *B*, thus determining the location of the center of pulley *A* at *a*, Fig. 1. The location of point *D* may now be found by again measuring to the right of *a*, along the center line of *A*, a distance *ap* of 1.94 inch. From *p* measure backward, horizontally and at right angles to the axis *A*, a distance of 3.12 inches, thus locating the point *h*. A plumb-line may now be dropped through the point *h*, and the distance from *h* of 3 feet 7.04 inches measured down along the plumb-line. This locates the point *D* in space. The location of the point *E* in space can be determined in a similar manner as follows: From *a* measure backward to the right a distance of 13.08 inches along the axis *A* and then forward on the horizontal line at right angles to the axis *A* a distance of 8 inches, thus determining the point *f*; through *f* drop a plumb-line and measure downward from *f* 3 feet 1.04 inches, thus locating *E*.

Of course other methods of getting these plumb-lines *hD* and *fE* in the proper position might be used. It can readily be seen that if there is a horizontal floor sufficiently smooth, the point where the two center lines of the shafts *A* and *B* cross each other, can be projected upon the floor by the use of a plumb-bob, and then the horizontal distances just used can be laid off on the floor so as to determine points immediately under *h* and *f*. Plumb-lines can then be dropped through these points, which lines will, of course, coincide with *Ef* and *Dh*.

Having located the points *D* and *E*, a line can be passed through them which will represent the center line of the axis of the idler shaft *C*. If, in Fig. 2, the points *Ds* and *Es* are taken at equal distances on each side of *Cs*, then, in Fig. 1, the center of the pulley *C* will lie at a height midway between the heights of *D* and *E*. The centers of the idler bearings may, therefore, be located with regard to the center of the idle pulley at any desired distance on either side by

measuring from the center of the pulley, along *DE*, the distances wanted. With reasonable care, the center line of *C* can be located in the above manner with sufficient accuracy for determining the position of supports to which the bearings of the shaft *C* are to be attached. When it comes to putting the bearings in place, however, if they are not adjustable in position, then it may be well to apply a check upon the correctness of position of *C*. This can be done in the following manner, which may be made clearer by assuming that the pulleys *A* and *B* are in place, although, as shown later, it is not necessary that they shall be: Stretch a vertical string between the pulleys *A* and *B*, corresponding to the stretch of belt connecting them directly. At the middle point of the length of this string, which point will be at a height midway between that of the axes *A* and *B*, fix a small staple, eyelet, or screw-eye attached to some rigid construction. A continuation of the string representing the belt may now be passed through the screw-eye and also placed upon the pulleys so that the positions of the center line of the belt will be truly represented, with the exception of the part at and near the screw-eye which is substituted temporarily in place of the idle pulley *C*. Now, upon the string or wire occupying the position of the idler center line, *DE*, attach a light, stiff piece of steel wire, which may be done either by wrapping one end of it around the center line, or by binding it on. Leave the free end projecting out about at right angles to *DE* and long enough to just about touch the screw-eye. If the string *DE* is twisted or turned, the end of this arm will swing about in an arc of a circle whose plane is at right angles to *DE*. Now bend the free end of the wire over so that it will describe a circle of a radius slightly less than the distance of the eyelet from the center line *DE*, and will just scrape against the side of the string where it leaves the eyelet. If the center line *DE* is in the proper position, then, when the free end of the wire is swung about in a circle by twisting the string *DE*, it will also just scrape against the side of the lower stretch of string running to the right of the pulley *B*, where it again passes by it at a greater distance from the eyelet. The end of the wire will also just scrape against the stretch of the string running up to the back part of the pulley *A*, at the same distance from the eyelet as it passed the lower part of the string. By the application of this method of checking, the center line of the axis *C* can be set with great accuracy. Doubtless it will be readily seen that the eyelet through which the string passes and which, in this case, is at a level midway between that of the upper and lower shafts, can be located before any of the shafting is in place. Also the two stretches of string running from the eyelet can be set in their proper positions before the pulleys are placed. It seems hardly necessary to give any method for doing this. When the strings, representing the center lines of the belt are in place, the manner of locating the points *D* and *E*, and of checking for the correct location of the axis *C*, is the same as above. With reasonable care in locating the center line *DE*, the bearings for the idle pulley can be so accurately set that when the pulleys and belt are put in place the belt will run correctly without any further adjustment of the bearings.

The eyelet for holding the string representing the center line of the belt has to be located at a height midway between that of the pulleys *A* and *C*, in this case, in order to correspond with the position of the point *M*, represented at *Ms* in the side view of Fig. 2 and at *ME* in the end view. If *M* had been taken one-third of the way down from the axis of *A* toward the axis of *B* in Fig. 2, the eyelet would also have had to be one-third of the way down from the axis *A* in Fig. 1, but still upon the center line representing the vertical stretch of belt.

It may not be out of the way to state, although it seems hardly necessary, that the drive should run in such a direction that the tight or driving side of the belt will be the one making direct connection between the pulleys *A* and *B*. This means, of course, that if *A* is the driver, the belt will have to move vertically upward from *B* to *A*; but if *B* is the driver, then the belt will run downward along the vertical stretch from *A* to *B*. If a belt of a width corresponding to the width of the pulley face shown in Fig. 1 is used, then it must necessarily have its quarter twist on the vertical stretch between *A* and *B* made so that its broad-side, and not its edge, shall be next to the idler *C*. This is the condition that naturally exists, however, in the ordinary method of running a belt, which is with the same side pressing against both the main pulleys *A* and *B*.

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POWER AND TRANSMISSION PLANT OF THE CLEVELAND TWIST DRILL CO.

An important and very interesting feature to be noted in connection with the works of the Cleveland Twist Drill Company, Cleveland, O., is the power plant which furnishes all the power for operating the machinery and lighting the works. Some time ago it became evident that a largely increased capacity in the power plant would soon be necessary, and after a careful consideration of the different means of providing what was necessary at the time, and also of how to provide for future expansion, it was decided to erect a power house entirely separate from the factory buildings, and to install therein an electric power plant and transmit the power electrically to the different locations and in such quantities as the circumstances might seem to demand. The equipment as it now stands is one of the most complete and modern in its appointments we have seen in connection with any machine works.

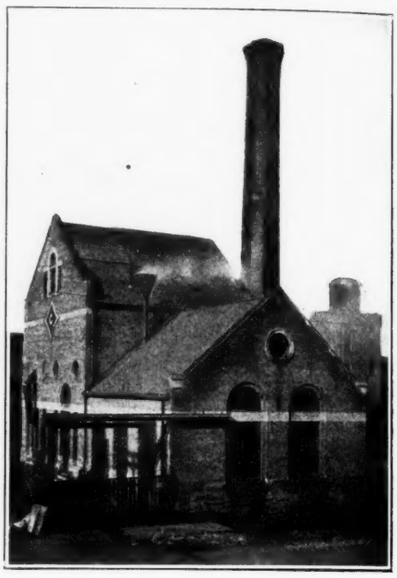

Fig. 1. Power House.

Realizing the rapid growth which had so far characterized their business, the company decided to erect a building for their power plant, decidedly larger than the requirements called for at the time, and at the beginning to place in position only a portion of the contemplated apparatus; but it may be said in this connection that their business has increased so rapidly, and they have been so well satisfied with the system of power transmission they have adopted, that already the

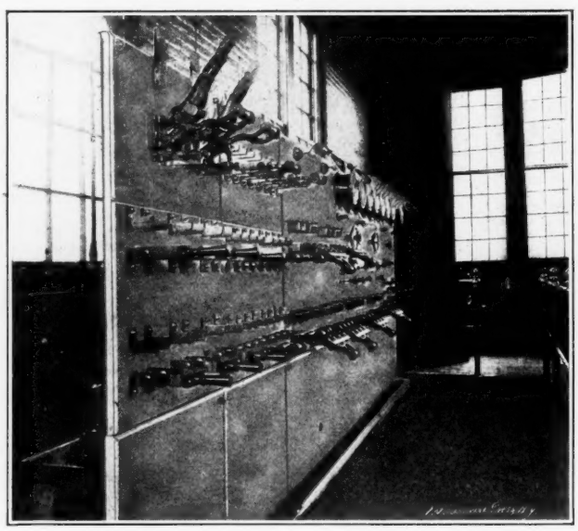

Fig. 2. Switchboard.

power house which seemed at first altogether too large, is completely filled, and they are now considering how they can still further increase the capacity.

Fig. 1 shows the outside of the power house as it is located on a spur track running into the property of the company, the lower portion near the front being the engine room, and the higher portion further back being the boiler room. The unusual height of the boiler room is necessary for the accommodation of the coal bunkers, located over the boilers, and which have a storage capacity of 300 tons of coal. The coal is taken from the cars to a vault below the tracks, where it passes through a coal crusher and from there it is carried by a conveyer to the bunkers referred to above. The same conveyer also carries the ashes from a basement below the boiler room, to an ash tank in the upper portion of the boiler room. On the left hand side of the boiler room, as shown in Fig. 1, may be seen a spout through which the ashes are discharged from the ask tank into a car.

Fig. 3 illustrates the inside of the boiler room, where the company have installed three water-tube boilers, together with automatic stokers of the chain grate type. Near the center of Fig. 3 may be seen the spout for conveying the coal from the bunkers above to the stokers, and also the scale for weighing all coal used.

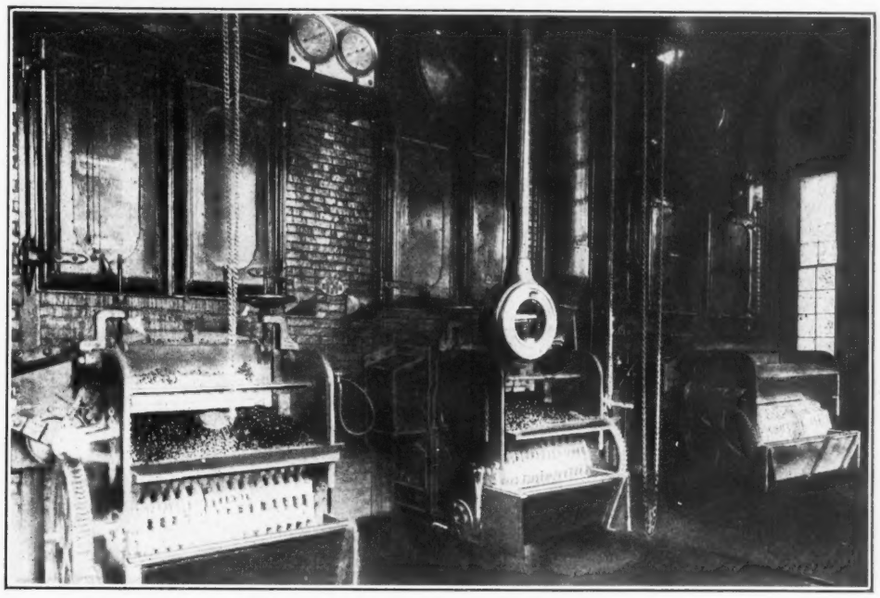

Fig. 3. View in Boiler Room showing Stokers, Weighing Apparatus, etc.

Fig. 4 shows a good view of the engine room in which are installed tandem compound engines using steam at a pressure of 140 pounds per square inch. These engines are of 350 horse-power capacity each, and are directly connected to generators furnishing a two-phase alternating current at an E. M. F. of 240 volts. The exciters for these alternators are made considerably larger than is necessary for exciting the fields of the machines, as they are required to also furnish a limited amount of direct current which is necessary for certain purposes about the works. The two units are operated either singly or in parallel, as requirements demand, and without the slightest difficulty.

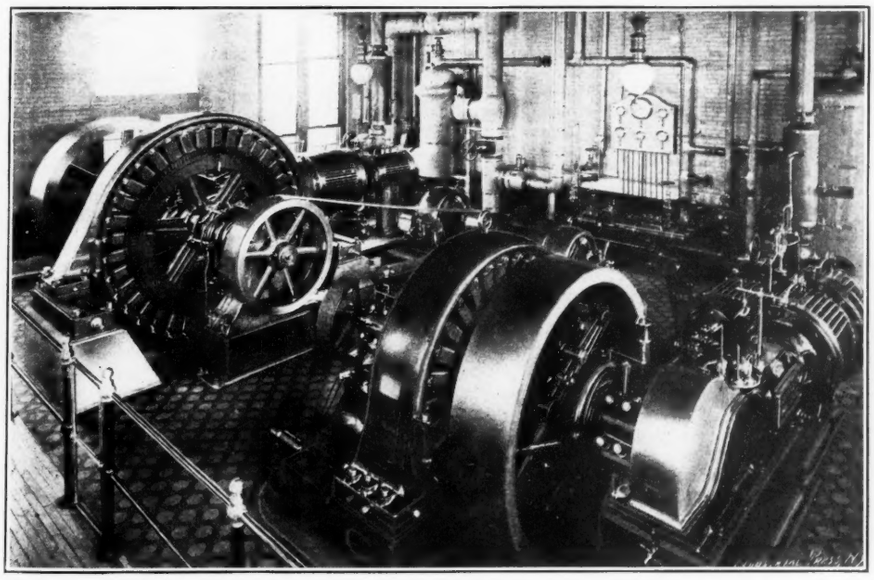

Fig 4. View in Model Engine Room, showing Engines and Generators.

Fig. 2 shows the switchboard, which is made of white Italian marble, and though simple in design, it presents a very neat and attractive appearance, and has proven itself to be thoroughly practical and adapted to the service it controls.

All feeders running from the power house are carried through underground conduits to the different buildings they serve. The conduits are made large enough to accommodate not only electric cables, but also steam pipes for heating and other purposes, and also to admit of easy access of the engineer or his assistants for making additions or repairs.

The motors for driving the machinery are all adapted for the two-phase alternating current before referred to, and run at a moderately slow speed, and in placing the motors careful attention has been given to the grouping of similar machines, and the selection of a motor of the proper power to operate these groups. In all cases the motors are located on specially constructed platforms hung from the ceiling, and in this way the entire floor space is left available for productive machines. A careful record is kept of the power required to operate the different groups of machines, and thus it is determined if the motor is a suitable one for operating efficiently under the load it has to carry. The lightning service is supplied with both arc and incandescent lamps operating at an E. M. F. of 110 volts, and great care and ingenuity have been brought to bear on this part of the work with a view of so distributing the circuits that under any ordinary running condition, the lighting load will be equally balanced on the two phases of the current furnished, and the result has been fully equal to what was anticipated in this direction.

The entire work of planning the above plant, as well as the selection of apparatus, and superintending its installation, was placed with George S. Rider & Co., Consulting Engineers, Cleveland, O., and it is pleasing to note that the operation of the plant, both as a whole and in detail, has been entirely satisfactory.

* * *

By the Kaiser's order fully fitted up ambulance trains have been placed at seventy-five German railway stations, and telephonic communication has been made with local doctors, so that any accident can be immediately dealt with.

ESTIMATION OF WEIGHT AND VOLUME.*

SIMPLE METHODS OF FINDING THE WEIGHTS AND VOLUMES OF IRREGULAR BODIES.

J. G. A. MEYER.

In the study of mensuration it must have been noticed that for the solution of many practical problems a knowledge of this subject is indispensable, especially when we have to deal with computing the weights of simple bodies; and in doing so we first find the volume of the bodies, say in cubic inches, according to the rules of mensuration and then multiply the number of cubic inches so found by the weight per cubic inch of the material under consideration, as given in the table. If the volume is found in cubic feet, multiply the number of cubic feet by the weight per cubic foot. In practice we have frequently to find the weights of bodies which cannot be classed with simple bodies, and it will therefore be advantageous to continue this study a little further.

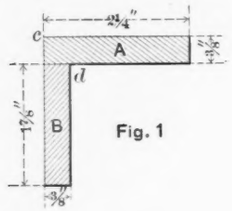

Fig. 1

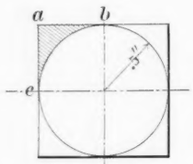

Fig. 3

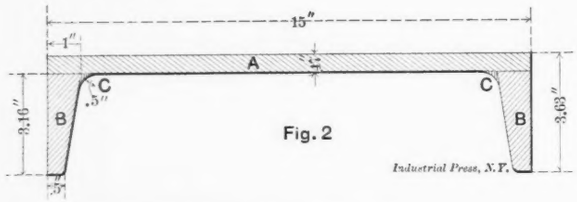

Fig. 2

Of course the general mode of procedure in finding the weight of any object of whatever form, is not changed; that is to say, we first find its volume and then multiply this volume by the weight of a unit of volume of the material.

Any piece of mechanism of whatever form can generally be divided into elementary bodies, but in making this division care should be taken to divide the piece into such simple bodies as will require the least amount of labor for computing their volume. The whole mode of procedure will be made plain by working out a few examples, commencing with the simplest form that can occur in practice.

In Fig. 1 a section of a square root angle bar is shown. Its outer sides are 2¼ inches long and have a uniform thickness of ⅜-inch. It is required to find the weight in pounds of this angle bar, per foot and per yard.

Before proceeding with the solution of this problem it should be remarked that, if it had been our purpose to show simply a section of this angle bar, it would have been decidedly wrong to draw the section lines in different directions. The section of a single body must always have the section lines drawn in the same direction; the reason for violating this rule in this instance is to show more distinctly the elementary figures into which this section has been divided, for the purpose of computing the volume of a given length of this bar. The same remarks apply to the succeeding figures.

In Fig. 1 it is shown that the section has been divided into two rectangles A and B. The rectangle A is 2¼ inches long and ⅜-inch wide; its area is $2.25 \times .375 = .84375$ square inch. The rectangle B is 1⅞ inches long and ⅜-inch wide, its area is $1.875 \times .375 = .70312$ square inch. The sum of these areas, or that of the whole section, is $.84375 + .70312 = 1.54687$; multiplying this total area by 12 inches we have:

$1.54687 \times 12 = 18.56$ cubic inches for the volume of the bar 1 foot in length. Multiplying this volume by the weight of a cubic inch of wrought iron, .2779 pound, we have:

$18.56 \times .2779 = 5.1578$ pounds per foot, or

$5.1578 \times 3 = 15.4734$ pounds per yard, if made of wrought iron; if made of other material we use the weight as given in the table.

The same result can be obtained by dividing the section into two trapezoids by drawing a line from the corner c to the corner d and then proceeding as before.

In Fig. 2 a section of a steel channel bar is shown. Its dimensions were taken from a list furnished by a well known rolling mill. It is required to find the weight per foot and per yard of this channel bar.

We first find the area of the section, and for this purpose divide it into three parts, A, B, and C. The part A is a rectangle, its area is $15 \times .47 = 7.05$ square inches. The part B is a trapezoid, its mean width is .75 inch; and its area is $3.16 \times .75 = 2.37$ square inches; these are two of these parts, and their combined area is $2.37 \times 2 = 4.74$ square inches. We must now make some allowance for the fillets C, C. For all practical purposes we may consider the fillet C to join two lines perpendicular to each other, under which condition the arc will subtend an angle of 90 degrees. We have indicated the area of the fillet on a larger scale in Fig. 3 by the shaded portion $a\ b\ c$; this area may now be computed as follows:

In Fig. 2 it is seen that the radius of the arc of the fillet is .5 inch, hence in Fig. 3 we describe with a radius of .5 inch a circle; around it we describe a square. Subtract the area of the circle from the area of the square and divide the remainder by 4. The result will be the area of the fillet. Applying this rule we have 1 square inch for the area of the square and .7854 square inch for the area of the circle. Subtracting we get .2146, dividing this by 4 we obtain .05365 which is the area of one fillet, and the combined area for two fillets is $.05365 \times 2 = 1.073$ square inches. The area of the whole section is the sum of the areas of its parts as found above, hence we have:

$$7.05 + 4.74 + .1073 = 11.8973$$

square inches for the area of the whole section; multiplying this area by 12 inches, we have:

$$11.8973 \times 12 = 142.7676 \text{ cubic inches,}$$

for the volume of one foot in length of the channel bar. Multiplying this volume by the weight per cubic inch of steel we have

$$142.7676 \times .2835 = 40.47 \text{ pounds.}$$

Table of Weights of Various Materials.

MATERIAL.	Weight in pounds per cubic foot.	Weight in pounds per cubic inch.
Aluminum..	166.5	.0963
Babbitt metal	456.	.264
Brass (65% copper and 35% zinc)	523.2	.3029
Bronze (average)	552.	.3195
Copper	552.	.3195
Iron, cast	450.	.2604
" wrought	480.	.2779
Lead	709 6	.4106
Steel	489.6	.2835
Tin	458.3	.2652
Zinc	436.5	.2526

per foot of length of channel bar and $40.47 \times 3 = 121.41$ pounds per yard.

In a similar manner we can find the weight of an I-beam.

In ordering angles, channels, or I-beams for any structure whose weight is restricted to a given amount, for instance the hull of a vessel, it is necessary to give the dimensions of the bar and the weight per yard required, otherwise there is a probability that bars during the process of rolling may be left slightly above or below size, making the bars too heavy or too light for the purpose required, which may lead to serious consequences.

If we have to find the weight of a cone pulley, probably the quickest way is to compute its whole volume as if it had been cast solid, and then compute its interior volume, and subtract the latter from the former. The result will be the volume of the metal in the cone pulley, and multiplying this by the weight per unit of volume will give us the weight required.

Estimating Volumes.

A very practical way is sometimes adopted for finding the volumes of irregular bodies. A tank of any convenient form —say rectangular, or cylindrical—is completely filled with

*This contribution was found among the manuscripts left by the late J. G. A. Meyer, the author of "Easy Lessons in Machine Design and Mechanical Drawings," and was sent to MACHINERY for publication by Chas. G. Peker.—[Editor.]

water, the solid is then carefully immersed, forcing some water out of the tank, and after this the solid is taken out and the level of the water carefully noted. The volume of the solid is now found by multiplying the area of the tank or water level by the distance from the top of the tank to the water level. The result will be the volume of the solid.

Frequently it is required to find the volume of the clearance space in an engine. The clearance space consists of the volume of a steam port plus the volume of the space between the cylinder head and the piston, when the latter stands at the end of its stroke. To compute this volume will, in many cases, be very laborious, and after all there will be no certainty that the result is correct, because in casting the cylinder the steam ports may not remain of uniform cross-section, nor have the form as designed. In cases of this kind the volume of the clearance space can be found in a very simple manner. Place the cylinder in a position so that the valve seat will be perfectly level, and place the piston in the cylinder at the end of its stroke; then fill the space completely with water, measuring it as it is poured in. The volume of the clearance space will be equal to the number of cubic inches of water poured into it.

We may also ascertain the volume of a solid by its weight. If the weight per cubic inch of the material of which the solid is made is known, divide the weight of the solid by the weight per cubic inch; the result will be the volume of the solid in cubic inches. Or if we divide the weight of the solid by the weight per cubic foot, the result will be the volume in cubic feet.

* * *

OUR MODERN MILITIA.

Periodically efforts are made to enforce the "blue laws" in various cities. Most of these pertain to Sunday observance, but none of them are any "bluer" than the laws now on the statute books with regard to the equipment of the militia of the United States. General Joseph Wheeler, in an article in Journal of the Franklin Institute, states that the law which is now nominally in force was enacted on the 8th of May, 1792, and amended the 2d day of March, 1803. The following is, *verbatim*, the present law with regard to arming the militia, as it is solemnly reproduced in the latest copy of the revised statutes of the United States (page 285):

"THE MILITIA."

"SEC. 1625. Every able-bodied male citizen of the respective states, resident therein, who is the age of eighteen years, and under the age of forty-five years, shall be enrolled in the militia.

"SEC. 1626. It shall be the duty of every captain or commanding officer of a company to enroll every such citizen residing within the bounds of his company, and all those who may, from time to time, arrive at the age of eighteen years, or who, being of the age of eighteen years and under the age of forty-five years, come to reside within his bounds.

"SEC. 1627. Each captain or commanding officer shall, without delay, notify every such citizen of his enrollment, by a proper non-commissioned officer of his company, who may prove the notice. And any notice or warning to a citizen enrolled, to attend a company, battalion or regimental muster, which is according to the laws of the state in which it is given for that purpose, shall be deemed a legal notice of his enrollment.

"SEC. 1628. Every citizen shall, after notice of his enrollment, be constantly provided with a good musket or firelock of a bore sufficient for balls of the eighteenth part of a pound, a sufficient bayonet and belt, *two spare flints* and a knapsack, a pouch with a box therein to contain not less than twenty-four cartridges, suited to the bore of his musket or *firelock*, each cartridge to contain a proper quantity of powder and ball; or with a good rifle, knapsack, shot-pouch and *powder-horn*, twenty balls suited to the bore of his rifle, *and a quarter of a pound of powder*; and shall appear so armed, accoutered and provided when called out to exercise or into service, except that when called out on company days to exercise only, he may appear without a knapsack. And all arms, ammunition and accouterments so provided and required shall be held exempted from all suits, distresses, executions, or sales for debt or for the payment of taxes. Each commissioned officer shall be armed with a sword or hanger and *spontoon*."

General Wheeler remarks: It will thus be seen that every member of the militia or state organizations, and as to that matter, practically all citizens of the United States, who are not exempted by law from militia duty, are violators of the law who have not supplied themselves with a musket or firelock, bayonet and belt, two spare flints, a knapsack, cartridges or a good rifle with shot pouch, powder horn, balls, a quarter of a pound of powder and various other things too numerous to mention, and at this time very difficult, if not impossible to obtain, and absolutely worthless for battle, if unfortunately they were obtainable. As but few of us have ever heard of a "spontoon," I will explain that it means a pike or a halberd or a long-handled weapon.

* * *

THE KINETOSCOPE FOR SCIENTIFIC INVESTIGATION.

The lecture rooms of the department of physics at the Massachusetts Institute of Technology, Boston, will be enlivened hereafter by the use of a kinetoscope. The machine is a first step toward equipping an instructor with apparatus that will enable him not only to illustrate his lectures with ordinary "motion pictures," but to transfer to the screen the continuous records of experiments in original research.

One of the many uses of the kinetoscope will be to illustrate the movement and character of air waves produced by the motion of any object, like the opening of a door, for example, The air is full of unnoticed sound waves, produced, not by sound, but by the various motions that make what we call sound. These waves travel at the rate of about 1,100 feet a second and yet it is asserted that they may be photographed under favorable conditions. The particular value of the kinetoscope for studying these waves lies in the fact that when the views are thrown on the screen in the lecture room the speed of the machine may be regulated to suit the observer and sound waves which actually travel at such extremely high speeds may be made to traverse the screen as slowly as desired.

Another use of the kinetoscope will be in showing the speed variation of a steam engine for the different positions of the stroke. The speed of an engine is kept constant within very minute limits by the inertia of the flywheel and where the flywheel is adapted to the conditions the variation can be detected only by the most sensitive apparatus. Alternating current generators, however, should have an absolutely constant motive power and it is thought that the kinetoscope will afford an excellent means for studying the variation in speed of steam engines and may assist in formulating rules for proportioning the weight of flywheels or in adapting the mechanism of the engine to the requirements of the generator.

Very often greater speed instead of less speed is required in exhibiting a phenomenon on the screen of the kinetoscope. The Smithsonian Institute, in Washington, has recently afforded an excellent example of accelerated speed in its use of the kinetoscope in studying the growth of a plant. Kinetoscopic pictures were taken steadily and systematically as the plant grew; a delicate piece of work which required several months before the film was complete, and involved the use of an automatic flash light and other contrivances in order that the hourly growth of the plant could be observed from first to last. When the film was finished, however, it could be run through the kinetoscope as fast as the operator wished. As a result the plant could be seen, in the compass of a few minutes, actually growing from seed to maturity, each stage of growth being in the same proportion to all others as in the original development of the plant itself.

* * *

Prof. William S. Aldrich is widely known as a mechanical and electrical engineer and has the faculty of bringing the enterprises with which he is connected before the public to a very proper extent. He is now director of the Clarkson School of Technology, Potsdam, N. Y., and has sent us a circular outlining a course in "Domestic Engineering," recently established at his institution. It is understood that some members of the faculty desired to call it a course in domestic science, but that this was overruled and the word engineering inserted by other members who had had experience in running their households when their wives were away. In case the course should not appeal to the new woman it very likely will to the new man.

* * *

Labor-saving machinery has made it possible to produce a bushel of wheat at the expense of the labor of one man for ten minutes. Seventy years ago it required the labor of one man for three hours and thirty minutes.

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JUNE, 1902.

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REPORTS ABOUT AMERICAN LOCOMOTIVES IN EGYPT.

The recently published report of the British consul-general at Cairo, Egypt, on the comparative performance of the British and American locomotives on the Egyptian State Railways, has awakened considerable international interest. It appears that the locomotives used on these railways are principally of British, Belgian and American manufacture. The American locomotives were purchased during the past five years and were ordered chiefly because of guaranteed quick delivery. From the report we gather that nearly fifty American locomotives were built for the railways in question, there being 30 freight, 10 passenger, 6 switching, and 2 experimental engines ordered at different times. As noted, the chief reason for placing the orders in America, was that locomotives were badly needed and they could be gotten here quicker than anywhere else. The advantages resulting from American methods of manufacture are strikingly illustrated by a comparison of two out of seven British and American bids tendered:

Bid No. 1. British price, $10,886. Delivery, 48 weeks.
Bid No. 4. British price, $15,795. Delivery, 90 weeks.
Bid No. 1. American price, $9,015. Delivery, 12 weeks.
Bid No. 4. American price, $11,028. Delivery, 30 weeks.

The American bids, as given above, were made on the basis of furnishing locomotives to one of the standard designs of the competing company, the Baldwin Locomotive Works, for which they were fully equipped in the matter of drawings, jigs, fixtures, templets, special machines, etc. The bids of the same firm for locomotives built to the standards of the Egyptian State Railways, were higher than the British bids in both cases, but the time of delivery was much shorter. So in the matter of manufacture the advantage was clearly with the American builder in point of time, but in the matter of economical performance as demonstrated by exhaustive and presumably fair competitive trials, the British locomotives were superior to a marked degree.

The average coal consumption of the British freight locomotives hauling 57 loaded cars, was 49.4 pounds per mile and the average evaporative efficiency of the coal burned was 9.1 pounds of water per pound of coal. The average coal consumption of the American freight locomotives in competition, hauling only 54 loaded cars, was 62 pounds per mile and the average evaporation was 7.78 pounds of water per pound of coal. These results are the averages of eight trials and the total distance was 1,034 miles for each competing type.

The difference in coal consumption was still more marked with the passenger locomotives. The average results of nine trains of 13 cars for a total distance of 1,345 miles for each type was 30.7 pounds of coal per mile for the British engines and 46.3 pounds for the American engines, while the average evaporation per pound of coal was 8.2 and 6.36 pounds of water respectively. Quite as remarkable is the result of the comparative trials of American compound and non-compound passenger locomotives. The average coal consumption of a compound locomotive hauling an average train of 12.8 cars a total of 2,121 miles, was 45.2 pounds; that of the non-compound hauling an average train of 12.4 cars, was 45.5 pounds. The average evaporation was 6.13 and 6.25 pounds of water per pound of coal, respectively. These results are the averages of 15 trips in each case.

The factors regarded by Major Johnstone, president of the railway board, as affecting the American locomotives unfavorably, are outside cylinders which expose more radiating surface to the atmosphere and cause greater twisting strains and greater friction than inside cylinders; increased friction and less perfect steam distribution due to comparatively short eccentric rods and the fact that they operate the slide valves through rocking levers, whereas in the British type the connection is direct. Offsetting these disadvantages are balanced valves, which greatly reduce friction in the valve movements, and finely graduated reverse lever sectors by which the expansion of steam in the cylinders may be closely regulated to the work, both of which features were not incorporated in the British type of locomotive used.

One feature of cylinder construction affecting American locomotives unfavorably is the large and excessively long ports leading from the valve seat to the cylinder. It seems strange that this feature of construction should not have been improved in general practice when it is so well known that long ports and large clearance spaces mean large losses from internal condensation. A longer valve or a double valve permitting shorter ports would undoubtedly make considerable difference in the eccnomy of the average American simple locomotive. However, the results of the trials on the Egyptian State Railways, appear to show that the great difference in economy of the British and American types lies not in the engines, but in the boilers, since the evaporative efficiency in all cases was decidedly in favor of the British type. Apparently our locomotive builders have room for considerable improvement in the design of the American locomotive to make it a more economical machine, if the results of these tests are to be accepted as conclusive.

PRODUCTIVENESS OF LABOR.

Of all the manufactured goods produced on earth, the United States contributes more than one-third, or 34 per cent. Her production of manufactured goods is nearly seven times as great as her proportion of population. Great Britain contributes 15 per cent of the manufactured goods of the earth, Germany 12 per cent and France 11 per cent. These figures suggest an extraordinary efficiency for the American workman. The average gross manufactured product, per hand, in the United States has a value of $1,900 per annum. The French workman, under the same definition, produces $650; the English, $485; and the German, $450. Of course, these figures, although comparable with one another, are not correct as representing the value of the manufacturing processes. The value of the raw material should be subtracted from that of the gross product before dividing it by the number of hands. This would reduce the figures, but practically in the same proportion.—Henry Gannett in *The Forum*.

These figures speak well for the American workman, but it must be remembered that the term "American workman" is more correctly expressed by saying "workmen in America." It is not necessarily the case that the American as an individual is more efficient than the Englishman or Frenchman, but it is demonstrated that workmen of all nationalities are more efficient when they live in America, become accustomed to American ways and methods, learn to use improved machinery and have become imbued with a little American energy. It is the environment, the improved methods and the training that count.

The possibilities in the earning capacity of an employee working under favorable conditions were never more strikingly illustrated than in the report of the United States Steel Corporation for the past year. It is shown that the *net* earnings were $111,000,000 and the number of employees about

158,000, each man thus earning $702 *net* for the company. The average yearly wage per employee was $712, so that the net earnings of each employee were within $10 of the wages paid him. That is, the profits of the company on the labor of each man were nearly as much as his wages. We are not now discussing whether labor in this case received its fair share of what it earned or whether the profits of the steel corporation were excessive or otherwise. We merely wish to call attention to the fact that labor under certain conditions becomes enormously productive, where, under less favorable conditions it may produce only barely enough for its own subsistence. The use of improved machinery and labor-saving appliances, together with the economies possible with so great and highly organized a business as that of the United States Steel Corporation, renders possible great profits at selling prices that under present conditions do not seem exorbitant.

STEAM TURBINE NOT INVENTED BY HERO.

The *Iron Age*, in presenting the subject of the steam turbine, says, "The thought suggests itself that the cycle of development in steam motors has brought us around very close to the starting point, and that this latest and in some respects most promising form of engine actuated by steam is, after all, a combination of Branca's wheel and Hero's eolipile. * * * The steam turbine combines the principles embodied in Branca's wheel and Hero's revolving eolipile in a modern mechanical expression * * * with no other important differences than that attributable to larger requirements and better appliances and materials for meeting them."

This is a sentiment frequently expressed by writers upon the steam turbine, but it contains more fiction than fact. We would wish to give old Hero full credit for what he did 2022 years ago, but did he and Branca strike the keynote of turbine success when they invented their steam wheels? We think not. Both Hero and Branca used the same principles that had probably been employed centuries before in water wheels and in no respect were their wheels essentially different from water wheels, either in regard to the wheels themselves or the way in which the working fluid was employed.

The important inventions which made the turbine adapted to steam relate to ways and means for utilizing the expansive force of steam. When water impinges against the blades of a wheel it does not expand and no provision need be made for its expansion. But with steam it is different. Unless provision is made for this expansion, the turbine is absolutely worthless as a motor, which accounts for the fact that only within a few years, or since the invention of means for using steam expansively in a turbine engine, has the turbine met with any success for steam power. Neither Hero nor Branca knew anything about the expansive force of steam, nor anyone else for that matter, until about the time of James Watt. If the inventors of the modern steam turbine drew upon the knowledge of the past, it was not from Hero's or Branca's work, but rather from those who have developed the theory of modern water wheel construction, and from the designers of the reciprocating steam engine. From the one they learned how to properly proportion the blades and guide vanes of their wheels; and from the other the necessity for expanding steam to its utmost limit when using it for motor driving.

MACHINERY EXHIBITS AT ST. LOUIS.

The Louisiana Purchase Exposition Co. has raised $10,000,000 for carrying forward this exposition and besides this the U. S. Government has appropriated $5,000,000 for the same purpose, which appropriation is entirely separate and distinct from any appropriations for the Government building or for the installation or care of the Government exhibits. This is about double the sum that was available for the Chicago exposition in 1893 and is very much in excess of the resources of any previous enterprise of this character. Every effort is being put forth to make the St. Louis exposition a great international fair.

Mr. Thomas M. Moore has been appointed chief of the Department of Machinery and he announces that the Louisiana Purchase Exposition Co. proposes to depart from the usual practice of expositions and to make no charge for exhibit space. Also to abolish charges for power, light and such facilities as may seem reasonably necessary for the best presentation and operation of a desirable exhibit—this, of course, within the discretion of the directors of the exhibits, and chiefs of departments. A charge will be made where power is used for regular manufacturing operations. In the matter of freight rates, facilities for hauling, unloading and erecting machinery, etc., the management proposes to do everything in its power for the protection and convenience of the exhibitors.

No decision has been reached as to whether there will be a building devoted exclusively to the exhibit of machine tools. Mr. Moore is anxious to hear from all prospective exhibitors regarding their plans, the amount of space each will require, the power to be used, etc. For this purpose blank forms have been issued which will be mailed on request. When these shall have been filled out and returned it can then be determined how much space to provide for the machinery exhibits. The machinery exhibits will be classified in five groups: Group 62, steam engines; group 63, various motors; group 64, general machinery; group 65, machine tools, and group 66, arsenal tools. For further particulars regarding this classification, address Mr. Thomas M. Moore, Chief of Department of Machinery, Louisiana Purchase Exposition, St. Louis, Mo.

* * *

NOTES AND COMMENT.

Abrasive methods of finishing work have become so important and are so superior to the old way of finishing with a tool or by filing, that some type of grinder is a necessity in any shop. One of the latest and most approved ideas in this respect is to supply the tool room with one or more grinding attachments, which can be checked out by the workman and used on his lathe like any other lathe tool. The advantage of such a system is that the grinder will then have all the rigidity of the lathe in which the work is turned and the grinding operation then becomes one of a continuous series of operations required for the completion of the piece. The piece requires no resetting or rechucking, as is the case when transferred to a grinding machine. While the regular grinder has obvious advantages for work done in quantities, the grinding attachment has just as important advantages when used on the miscellaneous work that must be done in every shop.

It is reported that the French government is to send young men to this country to study economic science and engineering. The reported plans are to keep about 200 boys for a four years' course in New York and Chicago, for economic science; and in Pittsburg and Chicago for engineering. At these places American methods will be studied and after the courses are completed the young men will return to France to put into practical use the ideas and methods they have gathered. This experiment was suggested through the annual exodus of American students to Paris to study music and art. Knowing that the United States had forged ahead in the mechanical arts and political science, and desiring to perpetuate the republican form of government in France, the idea presented itself of studying American institutions on the ground, as American art students do in France. Hence the government will select the brightest students at the various academies, and will pay their expenses, allowing them a reasonable amount of spending money while here.

During the past few months some remarkable work in the building of skyscrapers has been going on in New York City. Buildings costing at least $24,000,000 have been completed in time for spring tenants, or are nearing completion. A fifteen-story building at 68 William street was erected in record time. The contractors started to tear down the old building encumbering the site August 1, 1901; the first steel column was set in the basement November 9, and in twenty-five days the fifteen stories of steel work were erected. On January 9, 1902, the side walls, floors and roof were in place so that steam could be turned on in the building. The total time required for completing the building was about six months. Pneumatic riveters are employed to head the rivets

holding the component parts of the steel skeletons together; the high-speed freight elevator has replaced the laborer carrying the hod on his shoulder; and other labor-saving expedients are generally employed to facilitate modern building erection. The chief condition, however, that makes such rapid work possible is that all the component parts are carefully made ready before erection so that little or no fitting is afterwards necessary.

Labor Commissioner O'Donnell, of Minneapolis, addressed letters to a large number of wage-earners, asking them their views as to the effect upon the interests of labor of the great mergers or so-called trusts. The majority of replies stated that in the writers' opinions these larger corporations were beneficial to wage-earners; that the unions of workmen could deal with them in a more satisfactory way and that the employment was more certain and wages higher than where a contest had to be made with each individual employer.—*American Machinist.*

This is from an editorial upon the strikes and labor agitations that occur annually, our neighbor says, "with the approach of spring." It reads like a spring poem in prose, which would be beautiful if true; but Mr. O'Donnell removes the poetic element by saying, in a recent letter addressed to us: "I have had no answers that favor the great mergers or so-called trusts, that would lead me to believe that the unions of working men could deal with them in a more satisfactory way than they could were a contest to be made with the individual employer." We shall welcome the day when labor unions and trusts join hands in a friendly spirit, but evidently the time is not yet.

Apparently a very amicable agreement has been reached between the machine firms and machinists at Greenfield, Mass., by which a 55-hour week is to go into effect. Greenfield is a town of perhaps 8,000 or 10,000 inhabitants, in the heart of New England, a section where long hours are more of an established custom than in some other parts of the country. The firms affected are the Wells Bros. Co., the Goodell-Pratt Co., the Greenfield Machine Co., the Automatic Machine Co., the Massachusetts Tool Co., and probably F. E. Wells and Son. The *Greenfield Gazette* gives the following particulars:

A petition for a 55-hour week was handed in by employees of Wells Bros. Co. and at request of the company, the employees chose a committee to meet the firm. A friendly conference was held, the firm expressing their desire to grant the half holiday if they could afford it, and the employees not desiring to press for the privilege unless the firm could do it without suffering. The employees represented that they would do their best to make the change as little expensive to the firm as possible, and the request was granted. It is experimental in its nature, and its continuance depends on how much more it makes the goods cost. The employees of the Wells Bros. Co. passed a vote of thanks to the firm, together with a promise on their part to further the interests of the company to as great an extent as possible. The employees of all these firms will thus get a Saturday half holiday.

TESTS ON THE BANKI OIL AND STEAM MOTOR.

In the November (1900) issue mention was made of an internal combustion motor invented by Donat Banki in which oil and water are introduced into the cylinder in the form of a finely divided spray. The water is changed to steam when the charge is ignited, the effect being to keep the internal temperature down while the resulting pressure is very high. This allows the compression of the working charge before ignition to be carried to a greater degree than otherwise possible, as the cylinder temperature is kept within practical working limits. Since the greater the compression in this type of engine the greater the efficiency, the merits of the scheme are quite obvious. Recent tests made by Prof. Jonas, of the Budapest technical high school, on a Banki motor of 20 nominal horse-power, made by Ganz & Co., showed very good results. The consumption of oil, having a specific gravity of 0.73 at 59 degrees F. and a heat value of 18,323 B. T. U. per pound, was only 0.48 pound per brake horse-power when the engine was developing 26.38 horse-power; with a load of 20.7 horse-power the oil consumption was 0.51 pound per brake horse-power. The heat efficiency in the first case was 28 per cent and in the second case 26.4 per cent. With a brake horse-power load of only 8.21 horse-power the oil consumption was 0.71 pound per horse power and the heat efficiency was 19 per cent, a most remarkable showing for such an underload, the efficiency even then being equal to, if not superior, to most internal combustion motors when working at their normal load.

A NEW DEPARTURE IN SHOP PRACTICE.

The majority of concerns who have to use bolts, pins, studs and other small machine parts in large quantities have them made to order by shops equipped with automatic screw machines and where this kind of work is made a specialty, the pieces can be obtained much cheaper in this way than when made with ordinary screw machines without the automatic features, and comparatively few shops require enough small parts to make it profitable to install and operate automatic machines.

In line with this practice as regards small screw machine work the Potter & Johnston Machine Co., Pawtucket, R. I., have organized a new department for the purpose of machining to order small castings, forgings and other pieces that are ordinarily done in a chucking machine or turret lathe. A few years ago this company applied the automatic principle to the turret lathe and brought out an automatic turret lathe for operating upon pieces held in the lathe chuck, the general principle and operation of the machine being similar to the automatic screw machines that make small pieces from the bar. As a matter of course the machine will save much time over that taken by an ordinary hand-operated machine, through the use of the automatic principle; but, as in the case of the automatic screw machine, few shops have enough chuck work to be done to pay to install an outfit of automatic chucking machines.

The new department of the Potter & Johnston Machine Co. is equipped with machines for boring, turning and facing castings or forgings up to 6 inches long and 10 inches in diameter, such as gears, pulleys, collars, etc. This is an interesting step in the development of machine shop practice and we shall watch the success of the venture with much interest. We believe it to be the first instance where the experiment of doing automatic turret lathe work to order has been tried.

LORD KELVIN'S AMERICAN VISIT.

Lord Kelvin, who recently visited the United States, accompanied by Lady Kelvin, is easily the leading scientist of the day and has been rightly termed the dean of the electrical profession. He is 79 years of age, yet is active and in good health, and in the course of his life has participated in many of the events that have marked the progress of the age. During his trip he was tendered receptions in the various cities honored by his presence. In New York a reception was held at Columbia University by the American Institute of Electrical Engineers and other technical societies. In Washington the receptions and dinners were attended by many high in official circles. While in Washington Lord Kelvin testified before the Congressional Committee which recently reported in favor of the bill for the adoption of the metric system in the United States and expressed himself in favor of a gradual introduction of the system.

Lord Kelvin is a Scotchman by descent, but a native of Belfast. He was born in 1824. Dr. James Thomson, his father, was a well-known mathematician. William Thomson (Lord Kelvin) studied at Glasgow College and also at St. Peter's College, Cambridge, graduating in 1845. At the early age of twenty-two he was made Professor of Natural Philosophy in the Glasgow University, a post which he held for twenty one years. Five years before this he had already published a paper on "The Uniform Motion of Heat in Homogeneous Solid Bodies," which was followed by treatese on various other subjects. He has been a prolific writer, and among other questions which he has studied and upon which he as written is the subject of thermodynamics, his contributions on which are considered most valuable. He was among the first to appreciate the researches of Joule, and much of his experimental work was undertaken in conjunction with him. Other important questions engrossed his attention, such

as the principle of the dissipation of energy, ocean telegraphy, the ready reading of telegraphic signals, etc. The sounding machine and the mariners' compass, the mirror galvanometer and the siphon recorder are among the inventions of this eminent scientist. The final successful laying of the Atlantic cable is due to him in a great measure. Electricity in its various branches have probably received the greatest share of his attention.

Lord Kelvin is the possessor of a number of medals for his many inventions, and is a member of a large number of technical societies in different countries.

* * *

OBITUARY NOTES.

Mr. Owen McCabe, late president of the McCabe Boiler Works, Newark, N. J., died recently at his home in that city. Mr. McCabe was about 60 years of age.

Benjamin Franklin Hooper, late president of the Colwell Lead Co., New York., died on April 20, aged 45 years. Mr. Hooper was a member of a large number of business and social clubs.

William Lathrop Potter, manager of the North Chicago Rolling Mills, died in Chicago on April 20. Mr. Potter was appointed manager of the mills in 1859, a position which he held until 1889, when he retired from active business.

Alexander Angus McLeod, president of the Boston & Maine and of the New York and New England Railroads, died in New York City on April 19, aged 54 years. Mr. McLeod was also interested in the Philadelphia and Reading Railroad and in the Philadelphia & Reading Iron and Coal Co. He was prominent in railroad circles.

Henry Morton, president of Stevens Institute of Technology, died in New York City, May 9, 1902, aged 65 years. Mr. Morton was chosen president of Stevens Institute in 1869, the date of its founding by the will of Edwin A. Stevens. His work in connection with this institution of learning, the first in the United States exclusively devoted to mechanical engineering, may fittingly be known as his monument, although his work in other fields had marked him as a man of more than ordinary genius. Upon graduating from the University of Pennsylvania in 1857 he first took up the study of law, but because of his marked ability in chemistry and physics as demonstrated in a series of lectures on these subjects he was induced to abandon the career of a lawyer for that of a teacher. His lectures were marked by clearness of expression and facility of demonstration rarely equaled on the lecture platform. Those delivered for the benefit of the Franklin Institute in 1865 on sound, light, chemistry and related subjects established his fame in scientific circles. During recent years his work as an expert in patent cases involving electrical and chemical principles and apparatus has been very profitable, as he was universally recognized as a high authority on such subjects. It will probably be a matter of some surprise to many to know that in addition to his scientific talents he had a considerable talent for poetical work. Mr. Morton had contributed liberally of his private fortune to the support of the institution with which he was connected, having given at least $145,000 to its support before his death.

* * *

One advantage of the use of superheated steam over saturated steam, is that it flows through a pipe line at the rate of about 100 feet per second with the same drop in pressure as saturated steam requires to flow 60 feet per second. Consequently pipe lines for superheated steam do not require to be of so great diameter for the same power as those for saturated steam. The difference in diameter is, of course, in favor of superheated steam as radiation is thereby lessened. It should be added, however, that great pains must be taken with the insulation of superheated steam pipes lest they lose a substantial degree of superheat before the engine is reached. While less heat units will be radiated from a superheated steam pipe for the same area, the drop in sensible temperature as measured by the thermometer is much more marked.

THE A. S. M. E. PAPERS.

PRESENTED AT THE SPRING MEETING AT BOSTON.

As we go to press the American Society of Mechanical Engineers is in session at Boston, Mass. This is the regular spring meeting of the society, and the meetings are held at the Massachusetts Institute of Technology, which, because of its central location, near Copley Square, its large lecture rooms, and the fact that it is in a measure the engineering headquarters for Boston, is well adapted to the society's needs. The program announced for the entertainment of the visitors has already been published in these columns, and brief mention of the professional papers presented will be found in what follows.

The most important paper of this session is the final report of the committee appointed to codify and standardize the methods of making engine tests. At the New York meeting in December, 1900, a committee appointed to recommend methods for testing steam boilers made its final report; and to supplement this work the committee was appointed to consider the subject of engine tests. Preliminary reports were submitted at the two previous meetings of the society, and the report as it now stands comprises a pamphlet of 76 pages. The bulk of the paper is devoted to steam engine tests, and there are directions for making the various measurements, corrections and calculations involved, and for recording and tabulating the results. A few pages are devoted to gas engine tests.

Perhaps next in importance are two papers by R. H. Fernald, one upon "Working Details of a Gas Engine Test" and the other upon "A Method of Determining the Temperature of Exhaust Gases." At least, these papers offer a very valuable supplement to the engine tests report, in that they give more complete details than are probably to be found elsewhere upon gas engine testing. Mr. Fernald has made special investigations at Columbia University during the past two years, and has had an opportunity to bring together a great deal of detailed information, such as one in actual commercial work would scarcely attempt. In the course of his investigations it was found that there appeared to be no reliable method for finding the temperature of the gases escaping from the engine cylinder during the exhaust, owing to the fluctuation in pressure during that period, and the consequent fluctuation in temperature. A separate series of tests was conducted, therefore, and a method deduced for estimating the exhaust temperatures.

Of greatest interest to the shop man is the paper on "A Proposed Standard for Machine Screw Thread Sizes," by Charles C. Tyler, Pittsburg, Pa. The variation in sizes of machine screw threads, as produced by different manufacturers, is mentioned. The author suggests that a thread be adopted having the form of the Sellers or Franklin Institute thread, now so universally used for larger sizes of bolts and screws. For sizes of screws he suggests a series beginning with .05 inch and increasing by .01 inch up to .11. From this the increase is by .015 inch up to .180. Above that the diameters run .2, .22, .25. Above this, up to ½ inch the variation is by 1-32 inch. For the pitch of the thread a value is proposed about the same as is standard on the present screws of approximately the same diameter; where any variation is made it is toward a finer pitch. The equation for the pitch is $P = 0.23 \sqrt{d. + 0.625} - 0.175$. This is the same formula as that proposed by Mr. George M. Bond in 1882, and differs only from the one used for U. S. standard bolts in the coefficient which is 0.23 instead of 0.24. As a practical thread it is proposed to vary from the standard by making the flat at the top of the thread ⅛ of the pitch and that at the bottom 1-16, so as to give some clearance. The important measurement of a screw thread is considered to be the diameter in the angle of the thread and in order to compare the working gages with the standards it is proposed to use a device which has been developed in the different watch factories, and another which has been designed in the small tool department of the Pratt & Whitney Co. These devices are for comparing two threads and show the difference in diameter between them, which is the important measurement.

Another shop paper is on "Cold Working Sheet Metal in Dies," by J. D. Riggs, Pittsburg, Pa. It relates to the use of dies for working sheet metal, and describes many interesting examples of sheet metal work. As illustrating the extent to which sheet metal is replacing other materials it is stated that violin bodies are now stamped of aluminum and make good instruments.

H. M. Lane, Scranton, Pa., has a brief paper on repairing a broken cylinder, 60 by 100 inches, of a blowing engine, in which the cylinder head and part of the flange had been knocked out by water. A casting was made to take the place of the part of the flange that had been broken off and a brass patch was put on to hold the broken parts in position. Long bolts for supporting the cylinder head at this point were secured to a strap extending around the body of the cylinder back of the ports. Another similar break was repaired by putting the parts in place and covering with a clay patch. When this had set the clay was removed, the cast replaced on the cylinder and plaster of paris poured in to give a pattern for a casting such as was needed. By inserting a piece of tin, the pattern was made in two parts. Brass castings were made, the broken pieces attached to them, and the whole put in place and calked to a joint with the cylinder body. As in the first repair, straps were secured to the cylinder body, and long studs carried out to hold the head in position and relieve the strain on the broken part.

The subject of rolling mill work is touched upon in a paper on "The Flying Shear," by V. E. Edwards, Worcester, Mass. A flying shear is designed to cut the billets while in motion, thus saving the time usually lost in the cutting operation and making the progress of the billet through the mill continuous. Instances are given where such shears are in use and effect a large saving. The first one constructed consisted of a simple hydraulic shear trunnioned at the base to permit the knives to travel with the moving billet during the instant of cutting. A second shear is operated by hydraulic pressure, the pressure being intensified by steam pressure. The cutting takes place while the shear moves forward, and the cutting stroke is about 20 inches, six of which are required to sever the metal and the remainder to bring the shear up to the speed of the billet and to stop it again. The upper knife swings on a pivot. When the shear moves as fast or faster than the billet the knife remains in position, ready for cutting; but as soon as the motion of the shear becomes slower than that of the billet, the latter pushes the knife out of the way and the billet clears itself. Other interesting examples are mentioned, one of which is a shear cutting regularly 1½-inch billets at the rate of 2,000 tons in 24 hours. Another shear cuts cotton ties traveling at the rate of 25 feet per second.

In the June, 1901, number of MACHINERY mention was made of a stoker for locomotives invented by John Kincaid which is entirely novel, both because of the use to which it is put and its method of application and operation. The stoker is attached to the locomotive boiler in place of the fire door, and can be swung out of the way for hand firing if desired. The coal is sprinkled over the fire by means of a piston which operates quickly and throws it over the whole grate. The various features of this stoker are outlined by Fred H. Colvin, New York, and an account is given of its actual operation on a locomotive in a paper upon "Mechanical Stokers for Locomotives."

The question of liquid fuel is one that is receiving increasing attention, and is discussed in a paper by Chas. E. Lucke, New York, upon "Liquid Fuel Combustion." The author of the paper conducted a long series of experiments with burners of different designs. The burner which was finally successful took its supply of air and oil through a Y-pipe and discharged the mixture into a heap of broken stone, which became heated and vaporized the oil. The stone must be of magnetite or other formation not easily fused; but the fusing may be reduced by the use of a steam jet. When the proper mixture is supplied there is what the author calls an explosive flame, the vapor burning instantly among the stone fragments without escaping flame. Either refined or crude petroleum appears to work well, and gasoline or other oils may be used and at any air pressure.

Geo. H. Barrus, consulting engineer, Boston, Mass., presents a full summary of the results of the elaborate tests made by him upon various kinds of pipe coverings at the Manhattan Railway Co.'s plant, New York City. The tests that have been made before have been largely of a laboratory character, while these were on a large scale and of such a character as to correspond with the actual conditions met with in large installations, like those of the large power plants of New York City. We have already made mention of these tests in MACHINERY, in the January, 1902, number, where the results were briefly given. The coverings were bought in the open market, and the various forms of asbestos air-cell coverings appeared to be the most satisfactory.

An extended paper, of a descriptive nature, is by I. E. Moultrop and R. E. Curtis, Boston, upon "Recent Construction at the Atlantic Avenue Station of the Edison Electric Illuminating Co., Boston." This is one of the earliest stations to use vertical engines, and has been greatly enlarged. In making the changes a study was made of the most modern methods; and the station possesses many interesting features, partly because it represents very recent practice and partly because of certain peculiar conditions that had to be met, largely because of limited room.

Several years ago a paper was read before the American Society of Mechanical Engineers by W. B. Smith Whaley, Boston, Mass., upon "Electric Installations in Cotton Mills," and in the discussion question was raised as to the comparative efficiency of electrical and belt or rope-transmission in such establishments. At the present meeting Mr. Whaley gives somewhat extended data on the subject. One rope-driven mill is compared with two electrically-driven mills. The results are entirely favorable to the electrically-equipped mills. Further reference to these mills will be found under the "Items of Mechanical Interest" in this number of the paper.

In Brief.

Other papers are as follows:

"Elevator Safeties," by Chas. R. Pratt, Newark, N. J. A new design of safety appliance is described which grips the steel guide rails and brings an increasing pressure of the jaws to bear upon the guide rails as the speed increases. Adjustment can be made to stop the car for any given speed and in any given distance.

"A Roller Extensometer," by Gus C. Henning, New York. A description of an improved instrument for measuring the elongation or compression of a specimen under test.

"Technical Index and File," by R. H. Soule, New York. Description of a system, developed by the author, for filing and indexing articles of value which appear in technical papers, pamphlets, etc.

"Specifications for Steel Forgings, Steel Castings and Steel Boiler Plates," by Wm. R. Webster, Philadelphia. These are the standard specifications adopted by the International Association for Testing Materials, and are based on the practice of many large firms.

"Steel and Concrete Coal Storage Plant," by F. M. Bowman, Pittsburg. Pa. Description of the storage plant of the Lowell Gas Light Co., Lowell, Mass.

"Improved Indicator Cock for Engines," by A. K. Mansfield, Salem, O. This is a four-way cock which is to be so connected that cards may be taken from either end of the cylinder and from the steam space of the engine throttle, or from the exhaust pipe; or when used on the low-pressure cylinder, from the receiver space.

"A Swiveling Joint for a 16-Inch High-Pressure Steam Main," by R. E. Curtis, Boston, Mass. The joint consists of two elbows held together by a system of links. There is a gland and stuffing-box which allow the swiveling action and the links prevent the two sections from blowing apart and at the same time allow the joint to swivel.

"Some Details of Direct-Connected Generator Sets," by Wm. H. Bryan, St. Louis, Mo.

"A Graphical Determination of Piston Acceleration," by J. N. Le Conte, Berkeley, Cal.

* * *

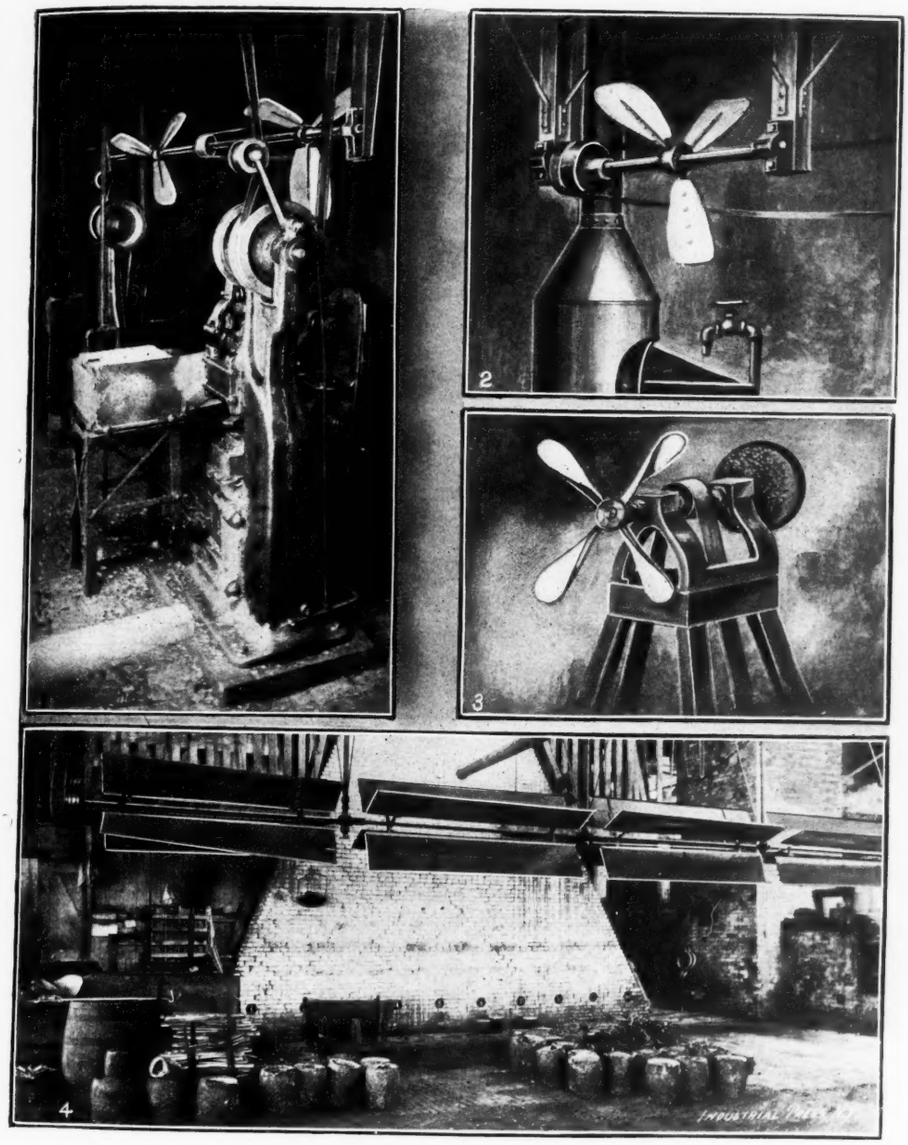
Tin, 80 per cent; antimony, 15 per cent; copper, 4½ per cent; and lead ½ per cent. are the constituents of the armature and motor bearings on one large street railway line.

LETTERS UPON PRACTICAL SUBJECTS.

KEEPING COOL.

Editor MACHINERY:

Now that the hot weather is near at hand one should remember the old rule of health, "Keep the feet warm, the head cool." A current of air will keep down excessive temperature of the body, since it absorbs the heat and at the same time carries off the perspiration. It also stirs up the surrounding atmosphere, bringing new and fresh air into circulation. If the shop is too small to be equipped with a system of blowers or exhaust fans, some relief may still be obtained at no great expense by rigging up home-made fans similar to those shown in the accompanying illustrations.



Fans in the Shop and Foundry.

Fig. 1 shows a row of power hammers with oil furnaces for heating the work. A countershaft over each hammer carries a fan, made of light sheet iron, which requires no appreciable power to run, yet affords a considerable degree of comfort. Fig. 2 is a case-hardening furnace similarly equipped. Fig. 3 shows one of a row of emery grinders. Each machine carries two emery wheels, one at each end of the arbor. During the hot weather, if for any reason one wheel is not in use a fan made of sheet iron is put on in its place. By twisting the blades the current of air may be turned in any direction desired. Fig. 4 shows a brass foundry with a fan running the whole length of the shop directly over the furnaces. All of these fans are cheap and of simple construction and offer direct returns on their investment in the form of increased production, owing to the greater comfort of the workman.

It is a notable fact that India, which has for centuries been fanned by *punkhas* swung by *coolies* is now introducing Yankee blowers, run by electricity! W. H. S.

A RURAL EXPERIENCE.

Editor MACHINERY:

In these latter days many of the characteristics which were formerly peculiar to the rural settlers of New England have, as a general thing, entirely disappeared. And the quaint grammar and dialect of the "wayback" are now generally supposed to exist only in the "hayseed" jokes which are given us from time to time in the "funny column" of the papers.

It sometimes happens, however, that we run across a relic of the olden time in real life. Such an experience befell the writer a short time ago; and while it would not be fair to give any names or the exact locality, yet the story is too good to keep.

I was called upon to make some repairs on a certain plant of machinery which was situated in the country, about five miles from the city where I was employed. Of course, all the needed tools and supplies for the day had to be carried in the morning when I was taken to the scene of labor, as there were no connections with the city until night when I came home. All went well until the fourth day and the job was nearly completed, when the tool that was being used was broken. Here was a dilemma. If we had been in the city it could have been easily replaced, but there we were, "out in the woods."

"What is to be done now?" was the question. "Well," said I to one of the farmers standing near, "if you can direct me to a blacksmith shop within a reasonable distance I can get it mended well enough to finish our work." The man addressed answered, "Waal, I've got a blacksmith shop, but who'll run it?"

I told him that if he would show me the shop I would "run it," whereupon I was told to follow him. We passed up the road a short distance, turned in at a gate near a nice appearing farmhouse and started down a lane to a field a short distance away.

We arrived at length at a little building which was formed by boarding up the sides of a stack where hay was formerly stored and the "dutch-cap," as it is called in the country, made the roof. On our way down my guide said to me:

"I dunno as you kin dew much with the thing, 'cause there's a big hole in the bellerses. I hed a patch put onto 'em, but this ere damp weather we've hed lately hes made it come off."

By this time we had reached the "smithy" and found it even so. I kindled the fire and my companion got in back of the bellows where the hole was and tried to hold it together while I tried to blow the fire. I worked for some time with very

indifferent success. After working for quite a while my companion said:

"I dew b'leeve them ere pesky squirrels hev got inter them bellerses agin. I cum daown here with another feller last fall an' we couldn't git any wind through the fire at all. At last I got a piece of wire an' commenced to poke it daown the nuzzle to see if it was stopped up an' tew gray squirrels jumped aout through the hole. We kept pokin' away an' I'll bet we got tew quarts of warnuts aout of the front end of them bellerses; an' mebbe thet's what's the matter naow."

We didn't look to see, however; but at last I got wind enough through the fire to answer my purpose.

I shall never forget that little blacksmith shop, the farmer and his "pesky squirrels." FREDERIC E. DURFEE.

Fall River, Mass.

SEAMLESS HOLLOW SPHERES.

Editor MACHINERY:

The writer witnessed an interesting process some months since in a little shop manufacturing copper floats, such as are ordinarily used on float-valves.

The process consisted first in spinning, out of sheet copper, in the hand lathe, hemispherical disks having flanges as in Fig. 1, or joints like Fig. 2, and then soldering them together into spheres. With an increase of business to the shop we presume that a drawing press will be introduced for forming the hemispheres.

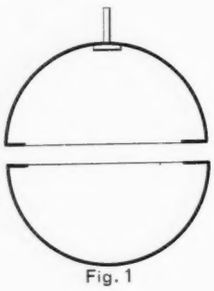


Fig. 1

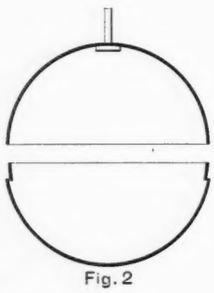


Fig. 2

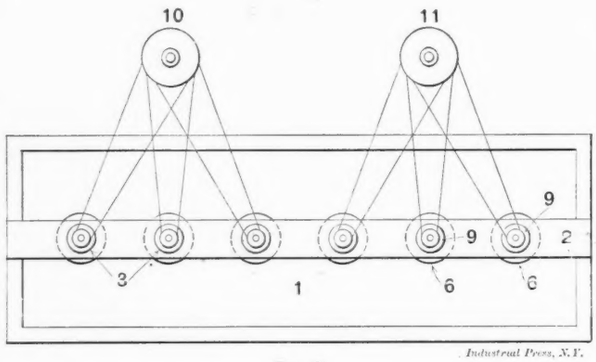


Fig. 3

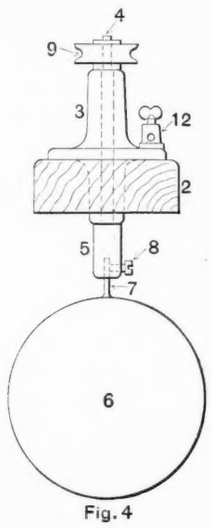


Fig. 4

Illustrating the Manufacture of Copper Floats.

Care is taken in the soldering to scrape off all superfluous solder, so as to leave a smooth surface at the joint. It is necessary to have a stem on each sphere, of a length sufficient to attach it to a revolving apparatus when it is electro-plated. This apparatus is placed directly over a bath, for the electrical deposition of copper or whatever sort of metal it is desired to plate the spheres with.

Fig. 3 is a plan of the apparatus as it stands on the plating tank. Fig. 4 is a detail of the journal casting, the pulley, the spindle, and of a float in place. A wooden bar, 2, runs lengthwise of the tank 1 and on this are screwed the journal castings 3 for the spindles 4. Each spindle is enlarged at its lower end, 5, and has a hole which receives the stem 7 of the float 6, this being secured by set-screw 8. A grooved pulley, 9, is fastened to the upper end of spindle 4 and is driven by a round belt from a pulley on the countershaft 10, several spindles being driven from each of the countershafts 10 and 11. Suitable electric connection is made with the journal castings at binding screws 12, the plates and positive terminal being arranged in the usual manner (but not shown on the drawing). The floats are given a slow, turning movement in the depositing tank, and as they revolve, the copper is electrically deposited on their outer surfaces.

The spheres having been spun true and round in the lathe, the deposition of copper forms a fine, smooth and true surface, the shell being of any desired thickness, commonly a sixteenth to an eighth of an inch in thickness.

Other circular forms can be readily plated in the same manner, giving a more smooth and even surface than when not revolved during the plating operation. C. D. K.

STEEL FOR TOOLS.

Editor MACHINERY:

I do not propose giving a scientific explanation of the term *tool steel*, or a description of the process of manufacture; but a few points which, if observed, may be the means of saving dollars to the user. I am often asked by manufacturers and men in charge of machine shop work, what make of steel I consider most satisfactory for general tool room use. I generally tell them that any of the leading brands will give satisfaction, if handled properly, which latter means a great deal. A method of procedure that gives good results with one brand of steel may be very unsatisfactory when applied to another; so it is highly important to obtain a general idea of the nature and peculiarities of the various makes of steel, or else to find some one brand that gives satisfaction and "stick" to it.

As a matter of caution I think it a good plan to test each bar of steel that is to be used in making any expensive tool. Cut a piece 3-16 to ¼ inch thick from the end of the bar; stamp the piece and the bar alike to save any confusion. Harden the piece cut off at a low heat; after taking from the bath, dry the piece and break it as nearly through the center as you can. The object of breaking it at this point is to enable one to detect any signs of the bar being piped, that is, having a hole or flaw running through it. This is an unusual defect but is occasionally found; and such a bar may be cut in the rack and the most expensive articles may be made from it before the defect is discovered. Even then the trouble is not always traced to the proper source; whereas if the defect be discovered in the test piece, the bar can be identified easily and returned to the maker.

If the piece is found to have been sound, we should next examine the grain, being very careful not to get any moisture onto the fracture, as it would discolor the steel. The grain should look fine and compact; if it has a coarse appearance, resembling cast iron when broken, it is unfit for cutting tools, as the outside cutting surface would not have the necessary backing that a cutter made of steel of compact grain would have. If the appearance of the fracture is satisfactory, take a smooth file—that is, a smooth-cut file, not one that has been worn smooth—and try the piece for hardness, being very sure to try it near the center, as the outside of a bar of steel seldom hardens well. If the file test is satisfactory, break one of the pieces in such a manner as to give a point, with

which you can scratch a piece of glass and if this point cuts easily and does not break, you can be reasonably sure the steel will harden enough for general use.

Yet steel may be of a fine texture and contain a high enough percentage of carbon to harden well, and still may not be tough enough for ordinary purposes. To test this quality, place one of the hardened pieces on a flat block of hard cast-iron or steel, and strike with a common machinist's hammer, the face of which you are sure is hard. It *should* require a pretty heavy blow to break the piece, but it should break before flattening very much, although the most satisfactory steel I have ever used would flatten slightly at about the time it broke. In connection with the file test I generally try driving a blunt-pointed prick punch into the steel, but where the grain is fine and compact and stands the file test, this is not wholly necessary.

The above method may seem a costly one for testing every large bar of steel, but it will be found the means of saving a great amount of money in preventing a bar of poor steel from getting into the steel rack. With a power hacksaw in the stock room, the cost of cutting off the pieces would not be worth mentioning, as the ends would in any case have to be cut off before using. As to the cost of testing, a reasonably quick man could test fifty pieces in a half a day at a cost of less than two dollars. This is a small item as compared with the cost of labor expended on almost any tool liable to be made from a small part of any one of the fifty bars mentioned, to say nothing of the delay occasioned if we find a defect in the steel when the tool is completed. If each of the bars is found to be all right it can be stamped O K, or marked in such a manner that the person cutting up the stock can readily see that it is all right.

Much unnecessary trouble would be saved if every one knew that the very outside of almost any bar of steel as it comes from the rolling mill, is not in a condition to harden. The action of the oxygen of the air is to destroy or burn out the carbon in the surface of the steel while it is going through the various operations of rolling and hammering; for this reason it is always best to pick out steel large enough to allow taking off a good chip before getting to the working surface.

These various tests here given, I would say in conclusion, apply only to *carbon* steels. The chrome and tungsten steels vary so much in their composition and characteristics, that each of them must be treated in a manner peculiar to itself. I do not say this critically, as many of them are excellent for certain purposes.

E. R. MARKHAM.

CUTTING AN ACCURATE KEYSEAT.

Editor MACHINERY:

The number of keyseats that are cut in pulleys, wheels, etc., with the ordinary hammer and chisel is enormous. While there are many machines for doing this work true and accurate, there seems to be still a large number of shops which are not equipped with a tool of this kind. It is rather difficult to do a "very nice" keyseat job by hand with the chisel and file; the finished keyseat is bound to be "a little out" somewhere. The little tool shown herewith was designed to enable the mechanic to cut the keyway in bores with a chisel (?) and to enable him also to do it without any fine steering of the chisel—in other words, it is a guide for the chisel.

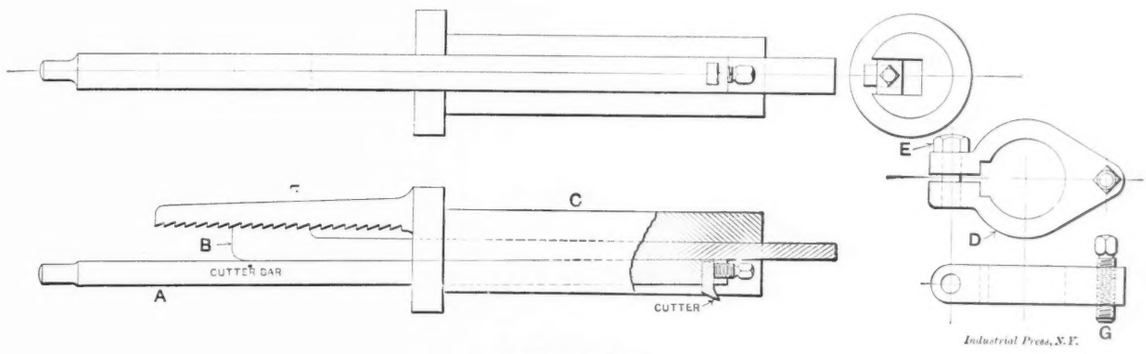
The body or casting *C* is of cast iron and is turned to a standard size to a shoulder, to which the projecting ratchet *F* is cast. A groove is planed in the body, as shown, and a long wedge-shaped cotter *B* is fitted to this groove. This cotter is extended back on its larger end, and teeth or notches are cut in the extending portion to fit the notches in the ratchet projecting from the main body. It will be seen that the cotter can be securely held in any axial position within the range of the ratchet.

A square tool holder, *A*, is also fitted to the groove, having in one end a slot for the insertion of a tool and a set-screw for holding same in place, while the other end is rounded for a striking point.

It is obvious that the tool can be inserted in a bore the same size or a little larger than its own diameter and the cotter, *B*, placed as high up or as near the end of the projection *F* as possible, and the tool set for a light cut. Then when the tool holder is being driven through, it is guided straight and holds itself for a continual cut. The tool holder drives clean through and then the cotter *B* is set down a notch or two and another cut taken and so on until the desired depth is reached. A "soft hammer" is preferable.

The collar *D* is for fastening or clamping on the end of the casting, which extends through the bore of the object or work; and setscrew *G* is tightened against the work to hold the body of the tool rigid, which is generally necessary.

For straight keyways or for slotting, another cotter is necessary in order to guide the tool holder parallel with the axis of body *C;* but the drawing shows the device ready for taper keyseating. A separate body is necessary for the different sizes of bores; but it is very inexpensive as compared either with a machine or with hand cutting and filing, as with this tool no filing is necessary after the last cut is taken. Of course it cannot compare with a machine keyseater when there is a nice steady power, as the power on this device comes "in jerks;" but it makes a nice groove or keyseat nevertheless.



Keyseating Tools.

BORING IN THE LATHE.

Editor MACHINERY:

It is often necessary to bore a hole so large that it is not convenient to do it in the ordinary way, by bolting to the face plate, and if the casting has no hole through, or one so small as to require a boring bar too small in diameter to get a steady cut, it is almost impossible of accomplishment on the boring machine. The casting shown, marked *C* in Fig. 1, is of such a nature. The primary factor in the boring of these cylinders is making the bracket *A*, which forms a solid support for the boring bar *B*. The boring bar *B* is driven in the usual way, or rather in one of the usual ways. It will be noticed that the taper shank is held from turning by being screwed into the spindle of the lathe headstock, and that it has a conical bearing at the outer end in the bracket *A*. The bearing is thus adjustable to take up "shake" by sliding the bracket *A* to the right along the lathe bed, which in this case is of the ordinary English pattern.

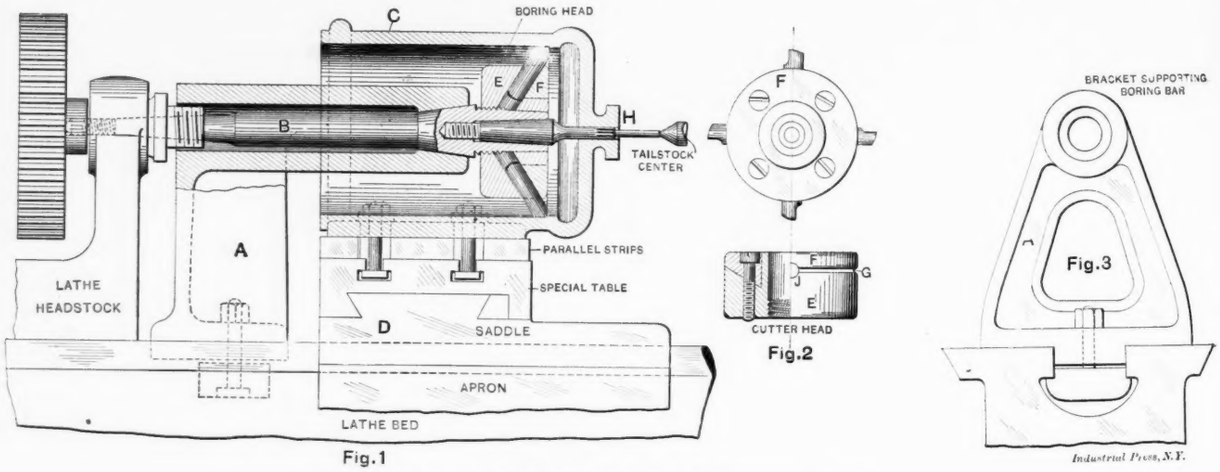
Of course, by making the bottom of the bracket to suit the raised V's, the attachment is capable of being made to suit the American style of bed.

The cylinder *C* is bolted upon a slotted plate attached to the saddle *D*, upon packing blocks. In planing the base of the castings, care was taken to make them in all cases of equal distance from the face of the base to the center of the casting—not to the core, as this was liable to be slightly "out."

Three cutter heads, two roughing and one finishing, were made like the one shown in Fig. 2. All had four cutters slanting to the left at the inner end, in order to bring the cutting edges outside, or near the end of the block.

Fig. 2 shows one of the blocks in detail. *E* is turned to the angle at which the cutters were required to be fitted at the point *G*, and a clamping ring *F*, turned to fit, was afterwards clamped on by means of four "cheese-head" (filister head) screws. Four holes, as at *J*, Fig. 2, were drilled in line with the joint to fit the cutters. After drilling a small amount was turned off the inner face of the clamping ring *F* in order that the tools would be clamped when the screws were tightened. This ring when tightened up was found to be sufficient to prevent the cutters slipping in.

To insure the cutters all having an equal cut, we ground the cutting edges and also backed them off by means of a cutter bar, mounted on the slide rest and driven from overhead. The finishing cutter finished from six to a dozen



Boring a Casting that is Difficult to Hold by Faceplate or Chuck.

holes at one grinding and it was then a simple matter to set them out a little and regrind. We found it paid to take out and grind the roughing cutters separately on an emery wheel, as working in the sand they wore rapidly. Sometimes one broke in cutting out a projecting lump of metal and they wore generally unevenly.

The hole *H*, Fig. 1, was bored out (from a cored hole) by two cutters, as shown (roughing and finishing), fluted similarly to rose bits or reamers. The roughing bit was passed through at the same time as one of the roughing cuts in the large hole; the finishing cut, however, was taken separately to avoid disturbing the large finishing cut. The saddle was fed up mechanically by means of the feed rod.

The tackle once made came in for many a similar job and took us out of a fix oftentimes. FRANCIS W. SHAW.

Birmingham, Eng.

AN AMBITIOUS MECHANIC.

Editor MACHINERY:

The ambition to know more about one's regular vocation, business or profession would seem to be a perfectly natural one and one that would be almost universal. There would not seem to be any kind of trade, profession or mercantile pursuit in which a better and more perfect knowledge would not bring corresponding benefits. We naturally feel more interest and consider more carefully, perhaps, the things which relate to our own business, and during a long experience in mechanical pursuits I have had many occasions to regret that our young men who expect to make the trade of a machinist their life work will persist in taking the short-sighted position they do in ignoring the opportunities continually before them to become better acquainted with their trade.

Many in the shops to-day, if approached on the subject of pay, would say that if they had known machinists were so poorly paid, they never would have gone into a machine shop. Why do they contend that they are poorly paid? And what are the reasons that they do not get more? Is it not that many of them do not use the means at hand for improving their knowledge of the business? Talk with foremen and superintendents as to the quality of their help and you are likely to find that one of their most common complaints is, "Oh, yes, we can get plenty of men; but so many of them are of no use to us. They pretend to be machinists but when we set them to work we find they never learned to do any one thing really *well*."

It would seem that this is the result of neglected opportunities. Some men come from the same shops that these men worked in who are first-class machinists. It is simply that young men do not *study* their work; do not endeavor to *understand* the "why and wherefore"; do not try to devise better methods of accomplishing the results desired; and, in short, do not "use their heads as well as their hands."

To learn a trade well, to be an expert, one must devote himself conscientiously to the work and learn all he possibly can about it. Sometimes it may be necessary, and it will always be advantageous to spare a little of the time usually devoted to pleasure to the study of mechanical subjects. And there never was a time when the practical experience of others, and the fullest details of the trade could be as readily acquired as at present.

When "the boss" has a new or a difficult job on hand he knows just what man to put on it; and it isn't the man who is always watching the clock, and grumbling because he does not get more pay, but, rather one of the progressive men who, he is sure, will "find out a good way to do it."

Not very long since a canvasser for a mechanical periodical went through the shop to get subscribers. He thought that perhaps the matter of cost would be an objection he would have to meet among the young men. But it was not so. When he offered to give the men a little time to pay their subscription, he was told: "Oh, it isn't that we haven't the ready money, but *we haven't time to read the paper if we had it*."

"Haven't time to read it," because probably it would take some time from the hours usually devoted to pleasure!

To the credit of machinists, in many cases this cannot be said, but with many of those who complain of low wages, and that "we never got any of the soft snaps," this and kindred reasons are sufficient to show the causes for the conditions. Let a young man of average ability and push, set out to learn the machinist's trade, determined to keep his eyes and ears open, to learn all he can, to observe and study all he can, and he will find that his knowledge and ability will surely

be recognized and his services be always in demand, at good wages. It is the man who knows just a little more, and who does his work just a little better than the "other fellow" who eventually gets the good jobs and "the soft snaps" in the machine shop, as well as in every other kind of business.

O. P.

STOCK ROOM.

Editor MACHINERY:

Those who have to do with shop management may be interested in the way we made accommodations for stock in the way of rough castings and finished parts. We would assume, now that we have such a place, that every well-regulated shop should provide a place for materials, where they will be easily accessible.

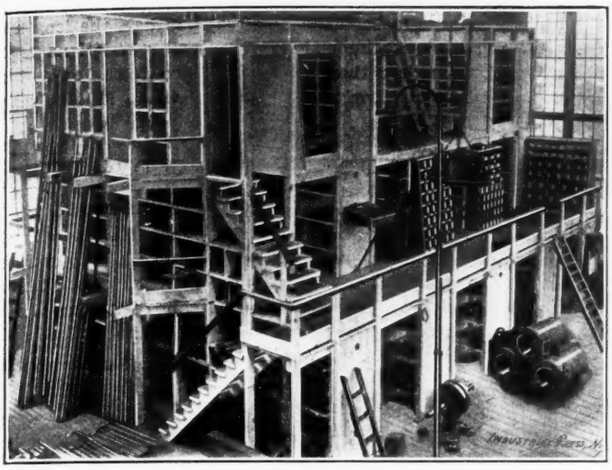


Fig. 1. View of Stockroom.

In our case the construction is unique owing to its location. It seemed best to store at one end of the erecting floor, which is about 70 feet wide by 200 feet long and 35 feet under the crane. Fig. 1 shows the general appearance of the structure, also the chain from the crane by which it is served. Materials are handled by the crane by means of a large pan made of a boiler head to which is fastened a three-strand sling for supporting it from the crane hook. This pan is shown in the illustration suspended from the crane over the first platform, loaded with cylinders.

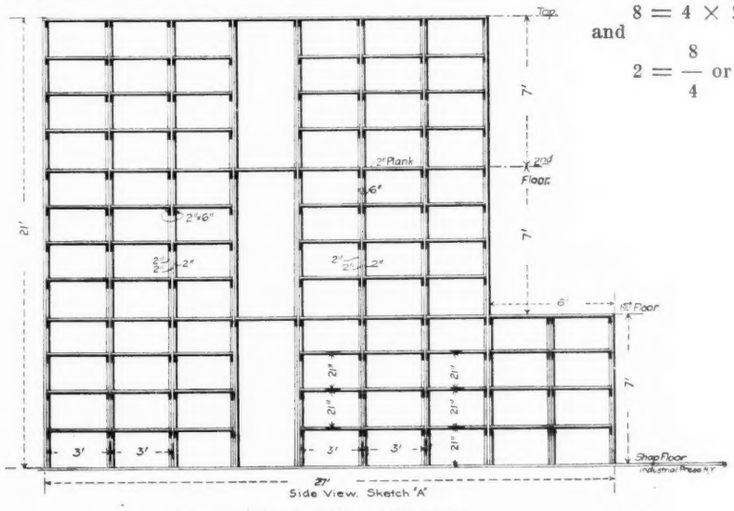


Fig. 2. Side Elevation of Shelving.

The structure has four aisles running from front to rear on each of its three stories, and one crossways on each floor, and it is 21 feet high. Some of the would-be wags call it the "Mystic Moorish Maze." There are about 1,500 shelves, where on one side the rough casting, and on the shelf at its side the finished article should be found, if any are in stock. At the right of each shelf is a tin card holder containing a card, Fig. 3, on which a balance is kept of material as it is taken in and sent out. We find this a very cheap way to care for our stock, as it requires only one man to keep this in order and give out material. A more elaborate system of card indexing would cost more, but we doubt if it would be any better, for our use at least.

Fig. 2 shows a side view of the construction. The timbers that sustain the load are all 2 inches x 6 inches x 21 feet high, and the boarding is all vertical, which gives great strength for the heavy materials stored on top, such as cylinders and cranks for engines. At present there is about 20 tons weight on top, and there are good indications of the shelves taking care of anything we see fit to put there.

We have many clever devices for doing work in our shop, but none are more appreciated than this convenience for finding things when wanted.

A. A. AVERY.

Warren, Pa.

A HELP IN USING FORMULAS.

Editor MACHINERY:

The use of formulas is not as general as their great usefulness would seem to warrant. No doubt the cause of this is, to a great extent, the inability of mechanics who have not studied algebra to think and reason with letters instead of numbers. This, however, can be overcome by replacing the letters in a formula by some small and easily remembered numbers. In this way the finding of the various formulas from a fundamental formula can be readily understood by any one acquainted with arithmetic.

For instance, take the well-known Ohm law as an example. This is stated in a formula as

$$C = \frac{E}{R} \quad ..$$

in which C = Amperes, E = Volts and R =Ohms.

From this formula we desire to find the value of both E and R; therefore, we take any number for the value of C. The number taken for E must, when divided by the number taken for R, be equal to the number taken for C. Suppose that for the value of C we take 4; for the value of R 2; therefore, the value of E is 8. Now, substituting the numerical values for the letters given, the formula reads

$$4 = \frac{8}{2}$$

From this it is the simplest mental problem to get the value of 8 or 2, thus:

$$8 = 4 \times 2 \text{ or } E = C \times R$$

and

$$2 = \frac{8}{4} \text{ or } R = \frac{E}{C}$$

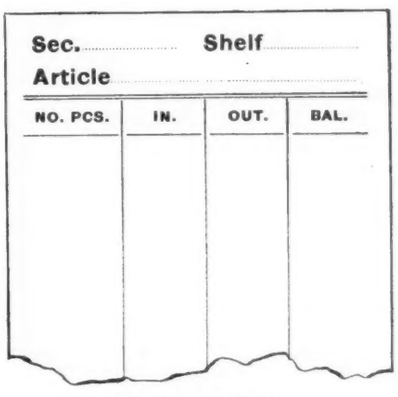


Fig. 3. Index Card.

Instead of placing the numbers separately, they may be placed near the letters in the formula, thus:

$$\begin{matrix} & 8 \\ 4 & E \\ C = & - \\ & R \\ & 2 \end{matrix}$$

The above simple problem will show how the use of numbers will be an aid in finding the values of the different parts of a formula.

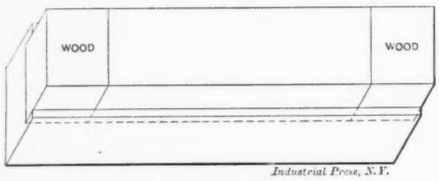
CHARLES G. PEKER.

AN OIL-STONE SETTING.

Editor MACHINERY:

I am not the originator of the oil stone setting herewith, but it is a good thing and I am sure it will be new to many patternmakers and other wood workers.

It is an eye sore to a mechanic to walk through the shop and see about nine-tenths of the oil stones on the benches worn hollow in the center like a sway-backed horse. This evil will be corrected if the stone is set in a block, as illustrated in the sketch, with pieces of hard wood about 1½ inches long at



Block for an Oil-stone Setting.

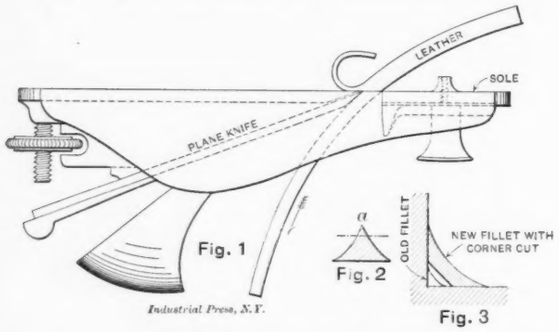
each end and flush with the face of the stone. This will enable the workman in sharpening his tools to whet over the ends of the stone as well as in the middle of it, thereby keeping it straight. Should the stone, after long use, show any hollow places, take a piece of No. 2½ sand paper, lay it on a flat board, turn the stone face down and a brisk rubbing will soon put it in good shape again. If the board is well chalked before laying the sandpaper upon it, the latter will not slip while rubbing the stone. WM. LUTZENBERGER.

Dayton, O.

CUTTING LEATHER FILLETS.

Editor MACHINERY:

A great deal of leather is used by the pattern makers for making fillets and lagging up patterns and core boxes; old belting, harness leather, etc., being mostly employed for this purpose. As it is necessary that the leather be of uniform thickness, it is the usual custom to tack a piece on a board and plane it down like wood. This, however, is not a very satisfactory way to secure good results. I send you a sketch showing a simple method of scarfing leather to any thickness



Using a Plane for Cutting Fillets.

by the use of a block plane. The throat of the plane is opened sufficiently to give the required thickness, and when the adjusting slot will not allow opening enough, the screw is taken out and the sole of the plane reversed, as in Fig. 1, thus securing an opening of any desired width.

It is sometimes necessary to put a large fillet into a corner already fitted with a small fillet. With the ordinary fillets, as shown in Fig. 2, it is almost impossible to secure a good job, but by cutting off the corner *a* it can be fitted very neatly, as will be seen in Fig. 3. This cutting can also be done with the plane. B. M.

GRADUATING STEEL RULES.

Editor MACHINERY:

I wish to suggest a way of graduating steel rules which will give the user the advantage of fine graduations when such are required; and he need not be confused with them when not required. I will take a 12-inch rule of what is commonly called the No. 1 graduations, for comparison. This is graduated as follows: First corner 10ths, 20ths, 50ths and 100ths. Second corner, 12ths, 24ths and 48ths. Third corner, 14ths and 28ths. Fourth corner, 16ths, 32ds and 64ths, the finer graduations extending one inch only for each number.

Suppose one wished to set a pair of calipers to 7.02 inches. He could not work from the end of rule—which is the quickest and most handy way when it can be done. Or we will suppose the measurement required was 4.02 inches. Now my way is to graduate the first corner in 10ths and 100ths; the second in 12ths and 48ths; the third in 14ths and 28ths, and the fourth in 16ths and 64ths, the finer graduations to extend half the length of rule in all cases.

To take the first measurement start at the end on which the coarse graduations are found and for the second start at the end which has the finer graduations. In other words, when the measurement to be taken is more than half the length of scale, commence at the end opposite the graduations to be used; and when less than half, commence at the end where the graduations required are found. M. H. BELL.

Watervliet, N. Y.

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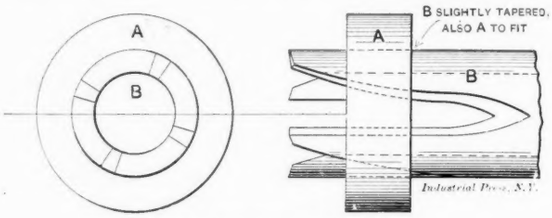
CONTRIBUTED NOTES AND SHOP KINKS.

HOLLOW MILL WITH TAPERED HOLE CLAMPING RING.

George I. Babcock, Providence, R. I., sends a sketch of a hollow mill which he has made and used with very satisfactory results. Instead of employing the ordinary split clamping ring tightened by a screw, he uses a solid clamping ring *A* having a tapered hole to fit the outside of the mill *B*. The



Hollow Mill Adjusting Device.

mill is slightly tapered toward the cutting end, and as the taper is slight the ring holds in any position in which it is set. If the diameter of the cutters is to be changed the ring is driven along on the mill and thus the diameter of the cutters is enlarged or contracted as the case may require. Mr. Babcock bores the hole in the mills slightly larger than the diameter of the work requires.

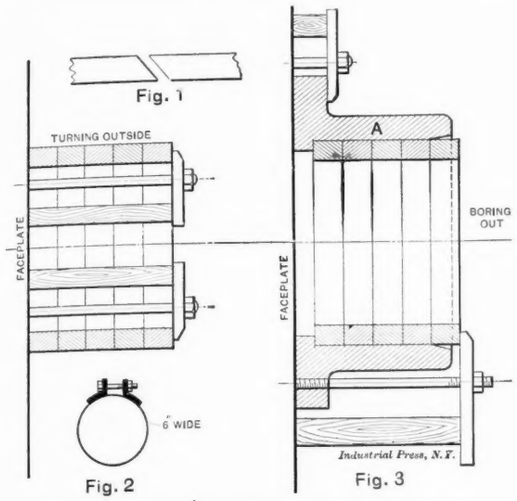
ENLARGING A CONE STEP.

Wm. Newton writes: I am not an agent for the sale of paper, but it recently filled the bill in enlarging the step of a lathe cone in our shop. The largest step on the lathe headstock had been enlarged for some special purpose by having leather belting nailed on it. One day, when the lathe was running at its fastest speed, the leather belting "took flight" and "winged its way" across the shop, carrying the nails with it. Not willing to have this repeated, I concluded to use paper instead of belting. I procured some of the thickest asbestos paper, also a sheet of the thickest manila paper, cut them into strips a little wider than the step, glued the strips on one side and put them in place on the pulley. The asbestos paper was thicker than the manila paper and fewer layers of it were required; but as it is of a spongy nature I thought it best to use the two kinds alternately, finishing with two thicknesses of manila paper. Enough layers were put on to enlarge the diameter nearly ¾ inch. I wet the back of the manila to prevent it from curling, and as each sheet was cut large enough to let each strip overlap where the last strip left off, I simply commenced with the next one. When the whole was perfectly dry I trimmed the edges and gave the exterior two coats of shellac. This made a good surface for the belt.

FINISHING PISTON RINGS.

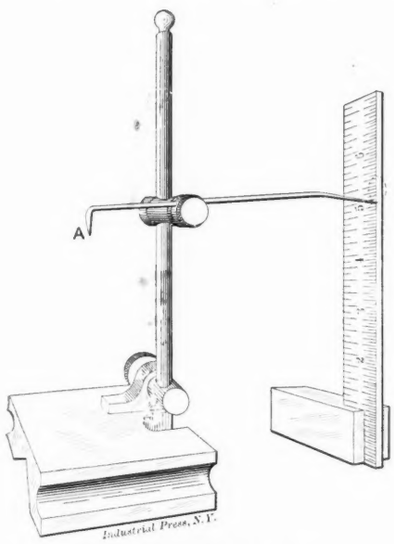
A. W. writes: Seven years ago I worked in an engine shop in Denmark engaged in the building of gas engines, and send you their method of finishing piston rings: These piston rings were turned in the ordinary way, the sides being faced and the rings split, as shown in Fig. 1. Five or more

rings were then laid together and drawn up by means of an iron band, as in Fig. 2, until the ends came close together. Next they were clamped to the faceplate, Fig. 2, with six clamps, the band was removed and the rings turned to the exact diameter of the cylinder. Finally the rings were put



into a cast-iron cylinder, *A*, Fig. 3, of the same diameter as the engine cylinder, the rings were again clamped and then bored out to the proper dimensions. This is a quick and accurate method.

TO ADJUST THE NEEDLE OF A SURFACE GAGE.



Kink for Setting Surface Gage.

C. W. P. sends a sketch illustrating the method of adjusting the needle of a surface gage. To set the gage 3¾ inch from the table, get somewhere within ¼ inch of the mark on the square. With the thumb and forefinger on crook *A*, turn the needle till it reaches the point desired. By turning the needle it will travel in the path indicated by the dotted lines shown, on account of the bend near the point.

DRILLING SMALL HOLES.

X. Y. Z. writes that he has often had trouble when drilling small holes, about 1-16 inch in diameter, to get them perfectly straight. His remedy or "kink" is to always have the drill sharp and to use it only so long as it cuts freely. Keep several drills of the required size at hand and only drill about ⅛ inch, then change for another that is sharp. If a hard spot is struck it can best be overcome by lowering the speed. Drilling small holes crooked is a common mistake, even by old hands, and one for which, in the majority of cases, there is no necessity.

* * *

Aluminum of average commercial purity (99.55 per cent) has an electrical conductivity of about 61 per cent of commercially pure copper of equal section, so an aluminum wire having an electrical conductivity equal to a copper wire has a square area of section in the ratio 1.64 to 1 and a diameter 1.28 to 1. Weight of aluminum for equal conductivity is .485 to 1; tensile strength for equal section, .46 to 1; and tensile strength for equal conductivity, .75 to 1.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

W. E. H. writes that he has trouble in keeping the hose couplings tight, which are used in connection with a pneumatic chipping machine, and would like to hear from some reader who has had similar trouble and has found a way to remedy it. The coupling that he uses is a screw coupling, and the two parts work loose and unscrew, from the vibration of the hammer. He has tried both right- and left-hand threads, with springs, pitch both 14 per inch and 18 per inch, but has the same trouble in every case.

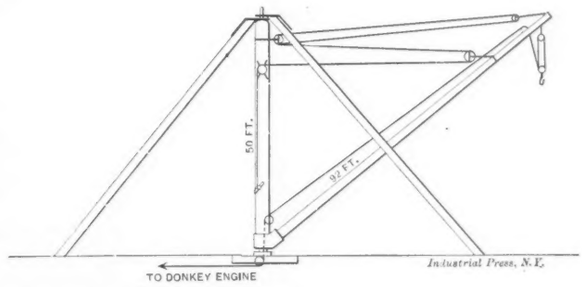
We submit to our readers the following inquiry from one of our subscribers in Vienna:

A. W.: Regarding the manufacture of machines for the mixture of dough I should like to know how machine parts of cast iron (that is, of the ordinary grey casting) or larger articles can be tinned in a bath of liquid tin over the fire. Of course, the surfaces have been previously dressed by being turned, planed or polished with a file. 2. I wish to give a bright tin finish to some small articles whose surfaces may not have been polished before being dipped in the bath, and also to some large pans for mixing machines, to prevent rusting. These pans have been polished on the inside by a lathe, but as these weigh from 299 to 1,500 kilograms, I cannot handle them easily over the fire. What is the American method for doing this work?

14. J. C.—In what respect does a hot sawing machine differ from a cold sawing machine? Are hot sawing machines regularly manufactured?

A.—In reply to a letter from us, the Cleveland Punch and Shear Works Co., Cleveland, O., write: As far as we know there is no concern that makes a specialty of building hot sawing machinery. A hot sawing machine for metal, such as is used in large mills, generally consists of a long shaft, with 30 to 40-inch saw blade on the end of same. In a large number of cases they are probably made by those who use the machines, and as far as we know there is nothing special about the saw blades.

15. G. H. S.—I am a hoisting engineer in a stone quarry on the Columbia River and send you a sketch of the derrick used in attempting to raise a sunken scow recently. The foot of the mast of the derrick jumped out of its socket and went 15 feet



before striking the ground. I should like to have the opinions of your readers as to whether I should have held the friction and so have attempted to keep the mast from falling, or should I have let go the friction as soon as possible?

16. W. S.—1. How should a gear be cut for a cast-iron pattern; also for a steel pattern? Can pattern gears be cut with the regular involute cutters? 2. If cutting with regular involute cutter No. 7, 3P., 14 to 16 teeth, can you cut a single curve tooth? If so, how? Or will it be a double curve? How do Brown & Sharpe cut theirs? How many changes should there be to finish a tooth? Will rolling a gear 1/32 inch and running a cutter through, make a perfect tooth? 3. If cutting a tooth 1/32 inch deeper than the proper depth, will a perfect tooth be formed? If the cutter is set 1/64 inch to each side and run through and then a No. 2 or No. 3 cutter is run through to cut 1/32 inch deeper, will a perfect tooth be formed?

These questions were sent to Mr. O. J. Beale for reply.

A.—1. A pattern gear for cast-iron has ⅛ inch to 1-foot allowance for shrink. A pattern for steel in most cases allows

¼ inch to the foot for shrinkage. The shrink in steel castings varies; it is sometimes not more than it is for cast-iron. 2. Pattern gears can be cut with regular involute cutters and the gears will run correctly. The double curve is little used nowadays. In cutting pattern gears, cut once through with the cutter central, then roll the gear and cut through again, thinning the teeth by cutting off one side. For a 3-pitch gear the teeth are about .026 inch thinner than a regular gear. See Brown & Sharpe's formulas in "Gearing," page 66. 3. Pattern gears are cut about 1/64 inch deeper on an average than regular gears. After the spaces are widened they can be cut deeper without touching the sides. The sides should not be cut when the cutter is set below the regular depth.

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17. H. B.—Kindly print a receipt for making impression wax, such as tool-makers use for getting impressions of dies.

We submitted this question to Mr. J. V. Woodworth, who replies as follows:

A.—To make impressions of dies in which the designs are very artistic or composed of many fine lines and curves use "modeler's wax." To make this wax, take two parts of bee's wax to one part of bayberry wax; dissolve and mix well, and spread over die while warm, first moistening the face of the die with a strong solution of soap water to prevent sticking. To secure impression of large bold designs, use "dentist's plaster," mixing it with water until about as thick as molasses. It will then be necessary to work fast, as the plaster will set quickly. Wipe the face of the die with a solution of lard oil and common soap and then spread the plaster over the die, running it from end to end. After the plaster has set heat the die slightly and lay it aside for about fifteen minutes, after which rap the edges of the die until the impression separates from it. To make large impressions of a plaster model, use glue dissolved in sufficient hot water to make it about as pliable as soft rubber when cold. Coat the plaster model with the lard oil and soap solution and pour the glue while hot.

* * *

SUMMER SCHOOL OF THE UNIVERSITY OF WISCONSIN.

The second session of the Summer School, conducted under the auspices of the College of Engineering at the University of Wisconsin, will take place from June 30 to August 8th. Our readers will remember that last summer we called their attention to the opening of this school, which, we are informed, has been very successful.

This school is for the purpose of giving stationary engineers, superintendents of power stations, machinists and others such mathematical, laboratory and shop instruction as would be found of practical value to them and which they could acquire in six weeks. Any person over 16 years of age, speaking the English language and with a fair knowledge of arithmetic will be admitted. The tuition fee for the term is $15 for all courses. In addition to this there are laboratory fees of five cents per hour for all time spent in such practical work. Courses of instruction are in: The Use of Formulæ; Mechanical Drawing; Steam Engineering; Shop Work in Carpentry, Forging and Machine Tools; Applied Electricity; Transmission of Power; and Strength of Materials. Further information can be obtained of Mr. J. B. Johnson, Dean of the College of Engineering, Madison, Wis.

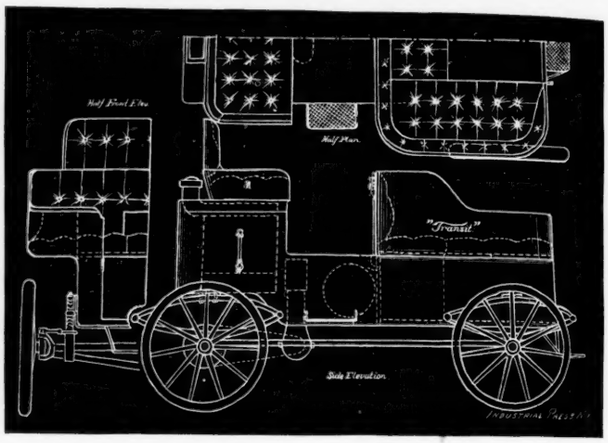
* * *

BLACKBOARDS AND AUTOMOBILES.

The blackboard is coming more and more to be a necessity in every drawing room. When the frame and other main features of a machine can be sketched full size, as is the case when a large blackboard is provided, the general proportions can be more correctly judged than when drawn to a smaller scale on a sheet of paper. One of the most complete blackboard outfits we have seen is at the Newton Machine Tool Works, Philadelphia. The board is large, covering one side of the room, and has two horizontal straightedges, one for each end of the board, the two being necessary because a single one would have to be so long as to sag at the center. The device for keeping the straightedges in parallel positions is simply that of an endless cord at each end, passing over pulleys at the top and bottom of the board, and attached to the end of the straightedge, as with the parallel rulers so often employed on drawing boards. For drawing vertical lines large T-squares are provided, the heads of which slide on the straightedges.

At the works of Riehle Bros., Philadelphia, is a blackboard divided into squares, like sectioned paper on a large scale. These squares serve to guide the draftsman in sketching in the outlines of a machine. Boards similar in design to the two mentioned are to be found in a great many drawing rooms, and there are probably many more having boards without either straight-edge attachment or sectioned surface.

From W. S. Rogers, Keene, N. H., we have received a photograph illustrating a still more novel use of the blackboard. Mr. Rogers is manager of the Steamobile Co., of Keene, and has recently brought out an entirely new design of automobile. This is equipped with the standard gear and motor made by this company, but the general proportions, connections, etc., of the new vehicle had to be laid out and this was done on the blackboard. Instead of transferring the dimensions and outline to drawing paper, however, and tracing



Reproduction from Blackboard Drawing.

and blueprinting them, the camera was brought into requisition, and photographic prints were made for shop use. As a result, the time spent in the drawing room was only three days, and on the fourth day work was begun in the shop. Exactly 16 days elapsed from that time until the machine was completed, tested and ready for the paint shop. The accompanying illustration is from the photograph, the dimensions and dimension lines, however, not showing in the reproduction.

A word should be said in this connection with regard to this automobile. Its normal carrying capacity is four people, but five can ride pleasantly and seven on a pinch. The passengers ride in a compartment isolated completely from the machinery, with their feet but 18 inches from the ground, and thus there is no fear of tipping over under any conditions. They have an unobstructed view of the road, and are not annoyed by the dust or odor that may arise from the motor. The operator can look over the heads of the passengers, yet his seat is no higher than in an ordinary automobile. The compartment in front may be changed for a package box if desired, and the conveyance turned into a delivery wagon. Mr. Rogers also has a plan for making this type of carriage with flanged wheels and using it as an inspector's car on railroads.

* * *

John D. Desmond, Milwaukee, Wis., in a letter mentions a test recently made on one of the highest buildings in that city to determine the water pressure obtained at a hoze nozzle on the top floor. The stand-pipe was 200 feet high and 210 feet and 350 feet of hose were attached to the top and bottom. With a pressure of 275 pounds per square inch at the fire engine a pressure of about 110 pounds was obtained at the nozzle. This would indicate a loss of head of about 78 pounds due to friction of stand-pipe and hose. Neither the size of stand-pipe nor hose was given. A test was also made of a 10-inch pipe line 1,500 feet long, the water being pumped into it from a fire boat. With 300 pounds pressure at the boat a nozzle pressure of 260 pounds was produced.

ITEMS OF MECHANICAL INTEREST, GATHERED FROM VARIOUS SOURCES.

UNIVERSAL JOINT.

We published in the April number an article upon universal or flexible-joint couplings, in which many different designs were shown. Since the article appeared, Gould & Eberhardt, Newark, N. J., have called our attention to the features of the universal joint they manufacture, which we inadvertently omitted to mention in connection with the others. To make our data upon the subject as complete as possible, we show herewith two sketches of the Gould & Eberhardt joint, the first being a general view and the second a detail drawing. The essential feature is a ball, which is in one piece, and has two grooves at right angles to each other turned in its surface, following the lines of great circles of the sphere. Tool steel bands, *AA*, Fig. 2, securely fastened to the end pieces or sockets, *S*, *S*, fit in the grooves and encircle the ball. There are no projecting parts to the joint and it has shown its capacity to withstand very hard usage, besides operating easily and without lost motion.

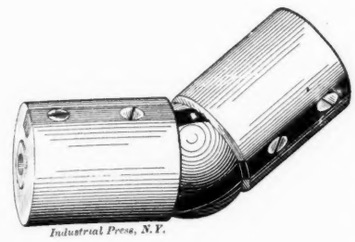


Fig. 1.

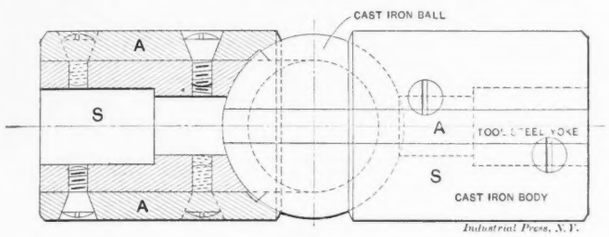


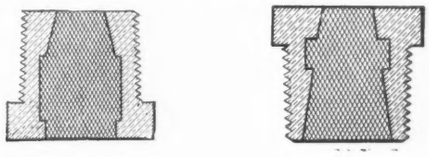
Fig. 2.

NEW TOOL STEEL.

The past year has been prolific in the production of special tool steels to meet the demand for the increased cutting speeds and heavy feeds now prevalent in general machine shop practice. One of the latest of these to come to our attention is the Schoeller-Express steel made at Ternitzer Stahl und Eisenwerke, Ternitz, Austria, works which have been producing steel since 1787. This steel is for sale in this country by the International Steel & Machinery Co., 245 Center Street, New York. The steel is made of the best Styrian ore and quoted tests with tools made of this steel show an excellent cutting quality and extreme durability. It is stated that in dry work the shavings will color from yellow to blue and the tool steel hold its edge, while if the work is cooled either by water or oil, the cutting speed can be increased two or three times without difficulty. One test upon machine steel lasted 38 hours and 40 minutes. The actual working time was 34 hours 26 minutes. The material was homogeneous with a tensile strength of upwards of 70,000 pounds. The depth of cut on a shaft 12 6-10 inches in diameter was ¾ inches; cutting speed 24 to 33 feet per minute; and 3,448 pounds of shavings were removed, this being at the rate of from 91 to 117 pounds per hour. The cutting edge at the end of the test is reported to have been in good condition and the turned surface of the shaft all that could be desired. The shavings were a light yellow and the tool had not been cooled. Directions are furnished for working and hardening the steel, the treatment being very similar to that required for the various brands of self-hardening steel.

UNITED STATES REQUIREMENTS IN FUSIBLE PLUGS.

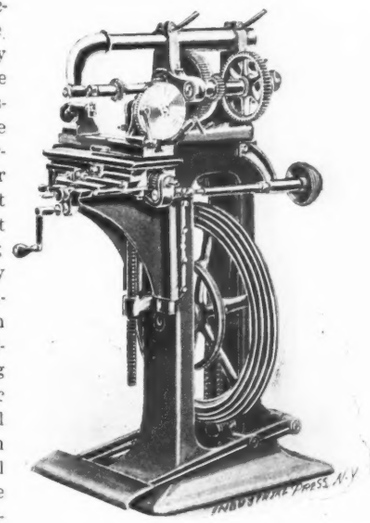
The United States Treasury Department is enforcing the provisions of Section 4436 of the U. S. Revised Statute regarding the specifications for fusible plugs, for use in boilers coming under the supervision of the U. S. Government. The statute requires that all plugs used on boilers or steam vessels shall be made of bronze and have no other filling than pure Banca tin. The action of the government comes as a result of the disastrous explosion last fall on the steamboat City of Trenton on the Delaware River, near Philadelphia. This explosion was caused, according to the evidence, by low water in the boiler, and although there were fusible plugs in the crown sheet, which should have melted and allowed the steam to blow out when the water level dropped below this point they did not do so, and thus no warning was given of the condition of the boiler until the danger point was reached. There seems to have been considerable doubt as to the composition of the plugs that were used; and while there are several compositions that melt at a low temperature, it is thought that Banca tin is the most easily obtained, is of a uniform quality and will always produce the desired result, as its melting point of 455 degrees F. is not altered by long exposure to heat.


Inside Type. Outside Type.

If plugs are to be accepted by the government they must be stamped with the manufacturer's name and an affidavit stating that they are filled with pure Banca tin should be filed with the inspector having charge in the localities where the plugs are to be used. The plugs shown in the accompanying illustrations are of the designs adopted by the Lunkenheimer Co., Cincinnati, O., as manufactured by them for a number of years. This company has made affidavit before the U. S. Steamboat Inspection Service to the effect that its plugs comply with the government requirements and are accepted by all inspectors throughout the United States.

ENGLISH AMATEUR TOOLS—FOOT-POWER MILLING MACHINE.

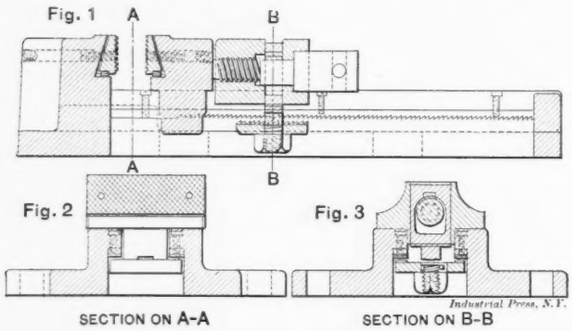
We have heretofore had occasion to mention the marked predilection of many English gentlemen of means and leisure for doing high-grade amateur mechanical work. It seems to be quite common for these amateurs to build really intricate and elaborate machines, like motor bicycles, automobiles and other machines requiring a high order of skill and workmanship in their construction to be of any practical value. Of course such work necessarily requires the assistance of machine tools, especially lathes; those employed are generally of the foot-power variety. It does not follow, however, that they are cheap tools; on the contrary, they are often elaborate machines, equipped with attachments for milling, slotting, grinding oval and eccentric turning, geometrical carving, medallion work, etc., the total cost of which may be several hundred dollars. The accompanying cut shows a foot-power milling machine built by G. Birch & Co. for amateurs, model-makers, etc., that is an example of the extremes to which the craze for amateur tools has led. It is difficult to imagine much of a market in the United States for such a machine. There might, indeed, be plenty of places where such a small milling machine would be appreciated when driven by power,


Amateur Milling Machine.

but with foot-power—it would be too much like slavery for the average American to operate. Therein seems to be a marked difference between the American and English nature. The former has plenty of nervous energy, but to be confined to a lathe or other machine which he must pump with his feet "to see the wheels go around" is far removed from a pleasurable task. That the Briton finds pleasure in it the facts just mentioned appear to indicate.

QUICK-ACTING MACHINE VISE.

Quick-acting vises have been the subject of many patents, but we have seen no simpler one than that shown in the accompanying illustration, reproduced from London *Engineering*. It is manufactured by A. A. Jones, engineer, Churchgate, Leicester, England. In Fig. 1 is a longitudinal section and cross-sectional views are shown in Figs. 2 and 3. The fixed jaw of the vise is cast solid with the base and the movable jaw is arranged to swivel so that taper pieces can be firmly held. The gripping power is obtained through a movable abutment, which slides behind the movable jaw. This abutment is provided with a lifting piece, having teeth



fitting into the corresponding teeth of two racks, fitted as shown in Figs. 1 and 3. The raising of the teeth into gear is effected by an eccentric on the screw as shown. In using the vise, the article to be gripped is placed between the jaws, and the abutment piece moved up into contact with the movable jaw. A quarter turn of the screw, by means of a turning bar, brings the rack teeth into engagement, and the further motion of the screw then forces together the jaws on the article between them. The vise jaws are faced with hardened steel pieces of taper cross-section, as indicated in Fig. 1, and continually pressed upward by springs. When the jaws are closed upon the work it is drawn down slightly, bringing it solidly against the base of the vise.

NOTE ON ELECTRIC DRIVING IN COTTON MILLS.

The Olympia Cotton Mills, Columbia, S. C., has a modern electrical transmission system, which has given excellent results on the score of economy. The following particulars were supplied by W. B. Smith Whaley, at the meeting of the New England Cotton Manufacturers' Association, recently held at Boston:

The operation of this plant under these conditions for six months has enabled us to obtain figures and data that I believe more than justify the adoption of this method of operating a cotton mill, as the results have been most favorable. The relative figures show that the combined losses from the cylinder to the work produced in the mill are much less than by the older methods of operation. Comparative figures would be as follows:

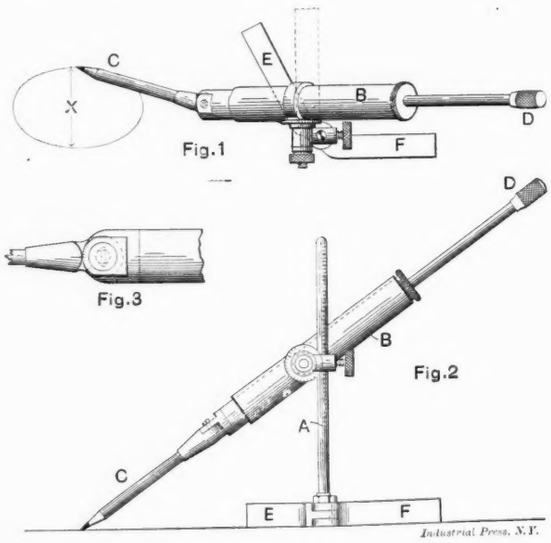
Rope driven mill	26
Electric driven mill	15

There appears to be a clear gain of eleven points in favor of the electric driven mill; measured in value of friction there is a net saving to the mill of 42.3 per cent of its friction. In other words, the efficiency of the motive power in producing work is increased from 74 per cent to 85½ per cent. These losses are going on all the time and amount to a considerable figure. A saving of this difference in any institution would mean a net dividend on its capital stock. It is safe to say that in many of the older mills the friction varies all the way from 50 per cent down, and the adoption of the electrical transmission in these plants would remunerate the company far more than the revamping of almost any other part of the plant.

The installation as compared with the rope or belt drive for mills exceeding 25,000 spindles is unquestionably as economical, if not more so, and in the Olympia it has proven itself much cheaper. The decreased cost of that installation is unquestionably many thousand dollars. The shafting and belting are one of the largest items of saving and have been cut in two, or even reduced to 40 per cent of the cost of shafting for the same distribution by a rope or belt drive.

INSTRUMENT FOR DRAWING ELLIPSES.

An ellipsograph designed and patented by Fred Oldfield, Chicago, Ill., is shown in the accompanying sketches. It consists of an upright standard, *A*, to which is clamped a barrel or sleeve, *B*, in which a plunger carrying the handle, *D*, and pointer or pencil, *C*, is free to either slide or revolve. This barrel can be set at any angle with the vertical and the pointer, *C*, can be swiveled to make any desired angle with the axis of the barrel, *B*. A detail of the joint between the pointer and the barrel is shown in Fig. 3. The instrument is operated by turning the knob, *D*, and at the same time telescoping it in the sleeve, *B*, so as to keep the marker in con-

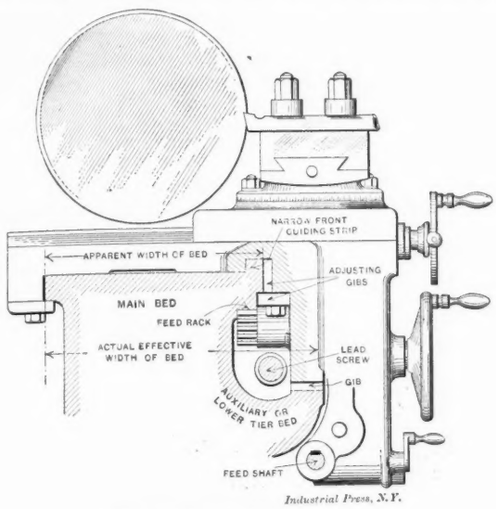


tact with the paper. The angle of the pencil determines the minor axis of the ellipse and the angle of the sleeve the major axis. The operation of the instrument depends upon the principle that when a cylinder is cut by an oblique plane the resulting section will be an ellipse. In Fig. 1 the ellipse indicated is equivalent to a section cut by a horizontal plane from a cylinder of diameter *x*, inclined at an angle with the plane equal to the angle made by the barrel, *B*. The purpose of the feet, *F* and *E*, which support the upright, *A*, is to enable the tool to be used in connection with a T-square or straightedge. The upright and the swivel joints for the barrel and pointer are suitably graduated so that the correct proportions for any ellipse may be readily obtained.

ENGLISH LATHE FOR HIGH-SPEED STEEL.

The introduction of high-speed steel for working metal has set all the steel makers of Sheffield to producing new brands of steel, and it has also set the machine tool makers to designing new forms of lathes and planers powerful enough to utilize the new steel which the *Engineer* intimates is not new, but only a re-discovery. Two English machine tool builders, J. Lang & Sons and Darling & Sellers, have recently brought out new designs, both of which are distinguished by a narrow "front guiding strip" to prevent twisting of the carriage on the ways. In addition to this feature the Darling & Sellers' lathe has an "auxiliary or lower tier bed" to give additional support to the heavy saddle. The accompanying cut reproduced from the *Engineer*, illustrates the principle of the de-

sign clearly. The name given it is "double-tier lathe bed." It will be observed that with this design the lead screw and feed rack come almost directly beneath the point of the tool when the work is of the proportion shown. The auxiliary support for the apron, which, by the way, is not bolted to the saddle as in American practice, but instead forms an integral part with it, increases the effective width of the bed to the degree noted in the cut. The advantages claimed for the new

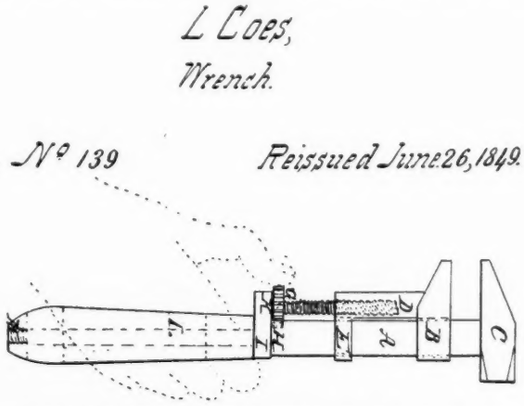


Cross section of Carriage and Bed.

design are, first, of course, that it is very stiff and rigid, and that the carriage always moves freely longitudinally, no matter how heavy the cut or great the speed. This latter condition is largely attributed to the comparative narrowness of the carriage to its length so far as the guiding strips affect it. The effective width of the bed to resist vertical thrust, however, includes the additional width of the auxiliary slide beneath the apron.

THE ORIGINAL LORING COES PATENT.

In the April number was published a portrait of Loring Coes, the inventor of the Coes wrench, the occasion being the 90th birthday of Mr. Coes and also the acquirement by him of all the stock of the Coes Wrench Co. and the union of the interests of the wrench department of Loring Coes & Co. with the Coes Wrench Co. We show below a reproduction of what is probably the first screw wrench patent drawing, made by Mr. Coes, and it will be noted that although the details of the screw wrench have many times been changed,



Copy of the Original Patent Drawing for the Screw Wrench.

the general form of the wrench has remained the same. We believe there is no small tool that has been used so long a time without radical change in shape, or that has been made for so long a period of years under the personal care and ownership of its inventor. Practically all the patents on the wrench are the product of Mr. Coes personally and they extend back to 1839. The cut shown is evidently from a reissue of the original patent, but this cannot be verified, owing to the loss of the records in the Patent Office fire. A new wrench is shortly to be brought out by the Coes Wrench Co., of which we shall have more to say later.

Mr. Coes has furnished an interesting item with regard to the adz-eye hammer, supposed to have been invented by D. Maydole some time in the sixties. He states that a Worcester Mass., blacksmith made him an adz-eye hammer for carpenter's use, and made more of them for other carpenters and woodworkers in the town. He thinks the blacksmith brought the idea with him from some other section of the country. He probably learned his trade in England.

* * *

EXTENSIVE BUILDING OPERATIONS.

The Deering Harvester Company, Chicago, are erecting a large steel plant for producing the various bars, angles and steel in other forms required in their extensive manufacturing operations. The company also own mines in the Mesaba range and when the steel works are in operation the Deering Harvester Company will be in an independent position as regards their supply of raw material. At least one and possibly several of the other large harvester companies own steel plants, but the Deering Company is the first, so far as we know, to control both the mines and the plant where the ore is worked into the various shapes for use.

Plans are well under way for extensive new works, to be erected at Newark, N. J., for the International Steam Pump Company. When the buildings are completed the International's equipment and business at their Elizabethport, N. J., shops and at the Brooklyn, N. Y., works (the Worthington plant) will be transferred to Newark. The projected works are very extensive and include an office building, an immense machine shop, with which is connected a building for testing and erecting pumps; pattern shop, power house, brass foundry, cleaning room, building for molding machinery, shipping department, warehouses and the main foundry, besides a number of smaller buildings for incidental purposes. The main machine shop will be 1,000 feet long and 125 feet wide. The total cost of the buildings alone will be more than $500,000 and the number of hands to be employed will be above 4,000. The plant will be the largest pump-making establishment in the country, and will contribute very largely to the prosperity and importance of Newark as a manufacturing center.

A pointer showing the immensity and rapid increase of the electrical manufacturing business of the United States, is the recent announcement that the great works of the Westinghouse Electric & Manufacturing Co. is to be practically duplicated, the company having decided to erect another building 1,800 feet long and 230 feet wide. This building, which will be known as the east extension, will be divided longitudinally into three bays, one high central one with monitor roof and two lower bays, one at each side. About 9,000 tons of structural steel will be required for the proposed addition. The machinery and general equipment will be about the same as those of the present works and the product will be of the same general character. The Westinghouse Machine Co. is also building an addition to its machine department for the building of the Parsons steam turbine, which may be taken as an indication that the steam turbine will soon become an active rival in the United States of the ordinary type of the steam engine for central station and general power purposes.

* * *

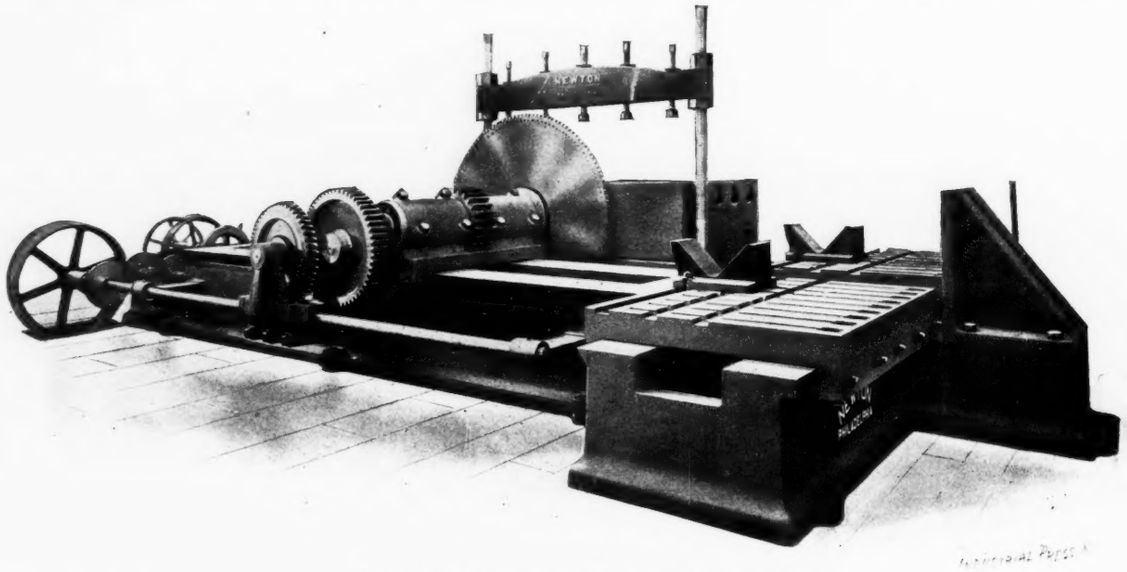
Sometimes it is desirable to make a print from a photographic negative, in a hurry. It is quite common practice in such cases to use common blueprint paper. Such prints may, if desired, be toned a rich brown color by immediately immersing the print after washing, into a solution of caustic soda and water, the caustic soda being about one per cent by measure of the water used. The print upon immersion in this solution assumes a yellow color. It should then be thoroughly washed and immersed in a bath of water and tannic acid, the acid forming about six per cent by measure of the water used. After the desired tint is obtained, the print is thoroughly washed and dried.

NEW TOOLS OF THE MONTH.

A RECORD OF NEW MACHINES, TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

HEAVY COLD SAW CUTTING-OFF MACHINE.

The illustration herewith of a new cold saw cutting-off machine made by the Newton Machine Tool Works, Philadelphia, Pa., is one of the largest and most massive machines of this character that they have produced. It is designed principally for making the two cuts required in heavy crank forgings, where the crank section of the forging is made solid and usually has to be worked out on the slotter. The



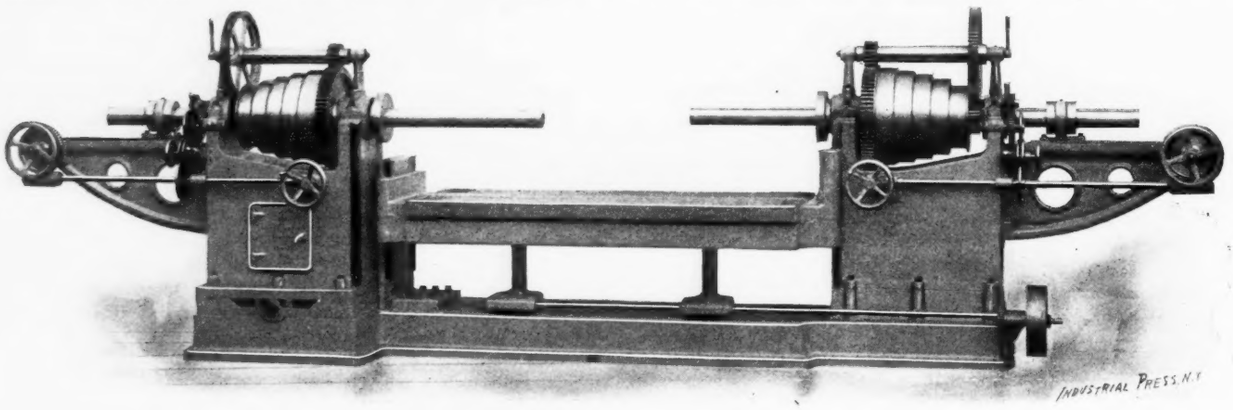
Newton Cold Saw for Cranks and other Heavy Work.

saw itself is 62 inches in diameter, and will cut into a crank to the depth of 21 inches. On the top table forgings 20 inches by 6 feet can be sawed off. The two tables appearing in front are arranged so they can be opened out to any desired width for convenience in handling different sizes of cranks. The crank shaft is placed in the V-blocks, one cut is made and the saw is then backed out and both tables are moved over simultaneously so that it is not necessary to reset the crank for the second cut. The large angle plate at the front of the machine is so placed that a jack can be used, should the crank forging pinch on the saw after being cut, which is frequently the case. By using a jack the crankshaft can be sprung and the saw backed out by power. The saw is an inserted tooth saw driven through a train of gearing, phosphor bronze worm wheel and hardened steel worm, having a variable friction feed, with power quick movement in either direction. When the saw is not used for crankshafts, miscellaneous forgings can be cut off on the top table. The shipping weight of this machine is about 70,000 pounds.

DOUBLE-HEAD HORIZONTAL BORING MACHINE

The Binsse Machine Co., Newark, N. J., have recently placed on the market a new horizontal boring machine. The tool was designed originally by the Westinghouse Electric & Mfg. Co., to bore the bearings in the frames of their street car motors. The frame completely encloses the motor, there being no openings except the four bearings for the two shafts. It is made in halves, which are first planed and then bolted together for boring the bearings. Many thousands of motors have been made, and accurate alignment is required both to secure quiet running as well as interchangeability of parts. The first machines made for this purpose had four sliding heads, which were fed up to the casting, two on each side, and which bored all four holes at once. Clearly the accuracy of this operation would be greatly affected by any inaccuracy of the heads, which, bearing in mind the quantity of motors to be bored, it would be very hard to keep up.

In the machine shown below, the casting is held in a cradle fixture, and the boring is done by two boring bars, guided in hardened bushings in the fixture. One head is secured to the bed-plate; the other has an adjustment crosswise, being bolted to a slide fastened to the bed-plate. The boring bar centers are thus fixed according to the distance between the motor shafts; and the heads are bolted fast during the boring. The table which carries the cradle and casting is adjustable vertically by power and hand. The feeds are of the simplest character possible, being an adaptation of the

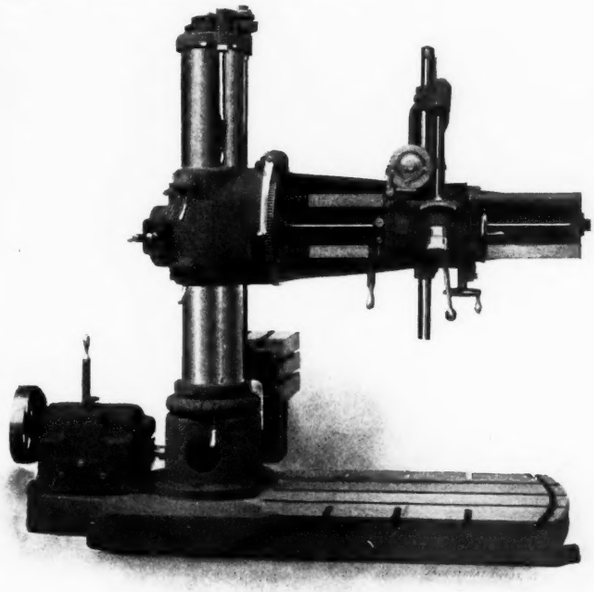


Binsse Machine Co.'s Two-spindle Boring Machine.

Sellers friction disks. There is no wear to affect the alignment of the machine, other than that of the boring bars. The principal dimensions are: Length over all, 25 feet; width, 5 feet; diameter of boring bar, 4½ inches; feed of boring bar, 51 inches. The table is 108 inches long by 38 inches wide. The machine complete weighs 25,000 pounds.

A NEW UNIVERSAL DRILL.

The Bickford Drill and Tool Co., Cincinnati, Ohio, have recently placed on the market the full universal radial drill here illustrated. This machine possesses a number of novel features and gives evidence throughout of a bold effort to introduce every means of augmenting production. The machine is provided with double the usual number of speeds and feeds, both of which are operated through nests of gears that give instantly any speed and feed without stopping the spindle A dial depth gage for reading all depths from zero, instead of between intermediate points on a fixed scale; a multiple automatic trip that can be set to operate at as many different depths as there are holes to be drilled at one setting of the work; an absolute safety device for preventing the spindle from feeding too far, and a tapping device that operates at all speeds, are features of this machine.



New Bickford Universal Drill.

The power is applied to a single driving pulley and is transmitted to the center shaft through the medium of a speed box mounted on the base at the left of the column. The single lever shown gives any one of four speeds without stopping any part of the machine. The back gears also furnish, for each set of driving gears, four changes of speed, each of which exerts at the spindle more than double the pulling power of the next faster one. They are incased in a box located on the back of the arm, from whence levers project to the front of the machine. The speed box and back-gear case give together 16 spindle speeds, each of which is obtained instantly by merely throwing the levers one way or the other. The proper location of this lever to give the correct speed for different metals and diameters of drills is shown in the figure attached to the front of the arm.

The speed box takes the place of the customary cone pulley. The advantages claimed for it are that it does away with all belt shifting; prolongs the life of the belt; gives great economy of power—the belt speed being constant and the pull, therefore, directly proportional to the power absorbed at the drill; it can be driven with unimpaired convenience from below the floor, when the arm is free to describe a full circle about the column; it permits setting the machine at right angles to the line shafting by using a quarter twist belt and is equally efficient when driven electrically because it permits the direct connection of a constant speed motor.

One of the novel features of the machine is the combined zero depth gage and multiple automatic trip. This trip is shown in the figure, set for drilling two holes. The setting is a very simple operation, a graduated dial being turned until it stops, when the dogs are set by the graduations according to the depths to be drilled. Any of the dogs can be rendered inoperative—if it is desired to drill beyond them—by simply lifting the latch on the clutch pawl, and if by inadvertence an intermediate dog is to trip, the feed can be continued without interruption by throwing the clutch in by hand.

The safety stop consists of a steel pin permanently secured in the face of the tripping gear and operates by tripping a fixed lip on the feed clutch pawl. It is impossible by any adjustment of the machine to traverse the spindle beyond the point at which this safety stop trips the feed, and the feed, in fact, cannot be thrown in again until the spindle has been raised.

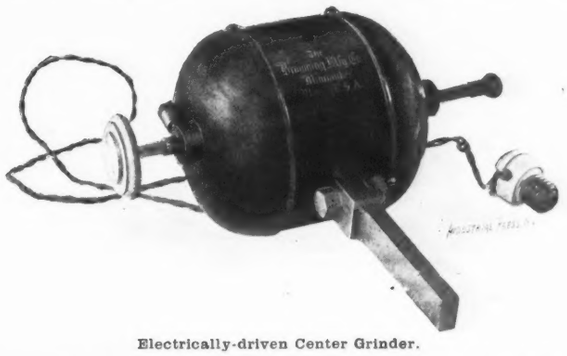
Great rigidity of frame has been aimed at by making both the arm and column of pipe section, so as to most strongly resist both twisting and bending stresses. The base is provided with a circular arc slot from which the end of the arm can be supported whenever the work being done calls for exceptional rigidity. Three sizes and four styles of this machine are now being built from designs and patents of Mr. H. M. Norris, the Bickford Co.'s works manager. The three sizes drill to the center of 8, 10 and 12-foot circles respectively. The illustration shows the smallest, the length of spindle feed of which is 15 inches.

A GROUP OF SMALL TOOLS ARRANGED FOR CONVENIENT REFERENCE.

ELECTRIC CENTER GRINDER.

The Browning Mfg. Co., Milwaukee, Wis., makers of electric motors from 1-20 to 10 horse power, have completed and perfected an electrical center grinder that will be found a great improvement over many of the grinders now in use in which the emery wheel is driven by a more or less cumbersome mechanical device.

The grinder is designed to be clamped in the tool post of the lathe and of course has any of the movements of the lathe tool block, the same as any lathe tool. In addition to these adjustments the wheel may be given a longitudinal or axial movement independent of the motor and grinder frame. This



Electrically-driven Center Grinder.

is accomplished by making the grinder armature with a hollow shaft, within which is the solid shaft attached to the emery wheel. The operator can give a reciprocating motion to the wheel and shaft by aid of the knob seen at the right-hand end of the shaft in the illustration.

The Browning grinder is not only a center grinder, but may be used for many other shop operations, such as grinding shafts, the face or center of dies, etc., and can be used in the planer or milling machine if desired. In the tool room it is useful for sharpening milling cutters, reamers, etc. It is made for either 110 or 220 volts, direct current, weighs about 20 pounds, and is supplied with a cord and plug for attaching to the electric light socket over the machine on which it is to be used.

DROP-FORGED CALIPER GAGE BLANKS.

J. H. Williams & Co., Brooklyn, N. Y., have added a series of steel blanks for caliper gages to the list of forgings which they carry in stock. These are in the form of double-end

gages, as shown in the accompanying illustrations, for sizes from ¼ inch up to 3 inches; and for sizes from 3 inches to 4 inches they are in the form of single-end C gages. These blanks are furnished in the unfinished state only and may be finished by the purchaser in a variety of ways to suit his requirements. The double-end gages, besides being finished with a single dimension at each end, as in Fig. 1, may be made in a variety of other ways for more than one or two sizes, or as limit gages. In Fig. 2, is a gage with one end of

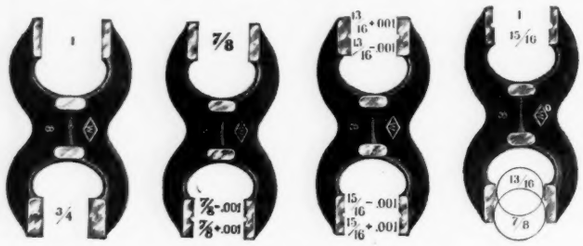


Fig. 1. Fig. 2. Fig. 3. Fig 4.

Blanks for Snap Gages.

exact dimensions and the other end for the plus and minus limits allowed. In Fig. 3, is a gage of the "go on" and "not go on" variety; two combinations. In Fig. 4, is a plain gage with four dimensions. The letter panels of these gages and the sides of the jaws are on the same plane and may be finished by a single grinding or polishing operation. If desired, the gages will be supplied of steel, suitable for tempering, and will also be made in sizes up to 6 inches.

LARGE LATHE DOG FOR HEAVY WORK.

A double-screw straight tail dog of new design is here illustrated. The manufacturers of this dog, the Billings & Spencer Co., Hartford, Conn., have taken into consideration the fact that recent improvements in lathe tool steel have led lathe builders to make heavier and stronger machines, powerful enough to do heavy work like turning large shafts, rolls, gun work, etc., and have prepared to meet the demand for large dogs suitable for this purpose. The dogs are made in two sizes, 5 and 6 inches, and weigh 25 and 35 pounds respectively.

Extra Heavy Lathe Dog

LATHE AND PLANER TOOL HOLDER.

The expense of using the costly self-hardening and high-speed steels for lathe and planer tools may be greatly reduced by the use of small sections of the steel in suitable tool-holders, as every one appreciates who is in the machine business. In most of these holders setscrews are used for

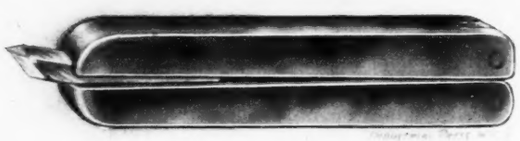


Fig. 1. New Tool Holder.

clamping the steel in the holder. Unless the holders are carefully looked after they are likely to become hollowed out on the seat directly beneath the point of the setscrew, which condition results in the steel cutter being either bent or broken when attempting to clamp it. The cuts, Figs. 1 and 2, show a new holder made by Storey & Sons, Mount Holly, N. J., which utilizes the clamping effect of the tool-post to hold the cutter in the tool-holder. The holder is made in two parts, each of which is grooved for the reception of the cutter. The two parts are hinged together at the back ends so as to be readily opened when removed from the tool-post. The hinge prevents the two

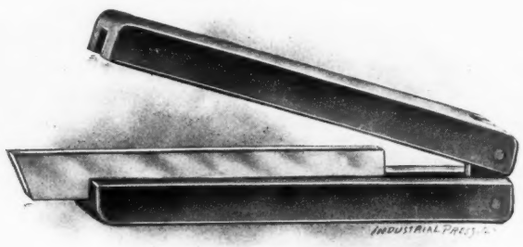
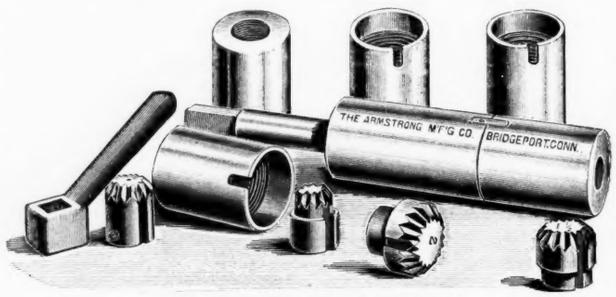


Fig. 2. Cutting-off Tool.

parts becoming separated and lost as would likely be the case if they were not fastened together. The clamping effect of the tool-post screw is distributed throughout a considerable part of the cutter so there is little or no liability of breaking it in the manner alluded to. Fig. 1 shows a holder for square steel such as used in turning and Fig. 2 is a holder for steel of narrow and deep section, such as used for cutting-off purposes, and it is designed for that use.

NIPPLE HOLDERS.

A new nipple holder has been made by the Armstrong Manufacturing Company, of Bridgeport, Conn., to be used in connection with their No. 00 pipe threading machine. It holds pipe from 1 inch to 4 inches inclusive by using different threaded rings and backing pieces. It will also hold close



Holders for Pipe Threading Machines.

nipples either right hand or left hand, no change of parts being necessary to hold the nipple for threading it left hand. When thread is cut the nipple can be removed with the fingers by loosening the screw in the back of the holder. This nipple holder can be furnished to hold as small as ¾-inch if required.

NEW OIL CUPS.

The self-closing oil cups made by W. W. and C. F. Tucker, Hartford, Conn., are now manufactured in a new form shown herewith, adapted for use on connecting-rod bearings, eccentric-rod straps, etc., on automobile engines. Heretofore the only means for oiling these important parts of the engine has been by a small hole drilled through the straps. These holes readily fill up with dirt and from the fact that the operator has to reach under the carriage to get at them are not easily accessible. The self-closing top oilers are designed especially to overcome this trouble and the oil holes can be reached, no matter in what position the rods may be. The oilers have an unusually large reservoir for oil.

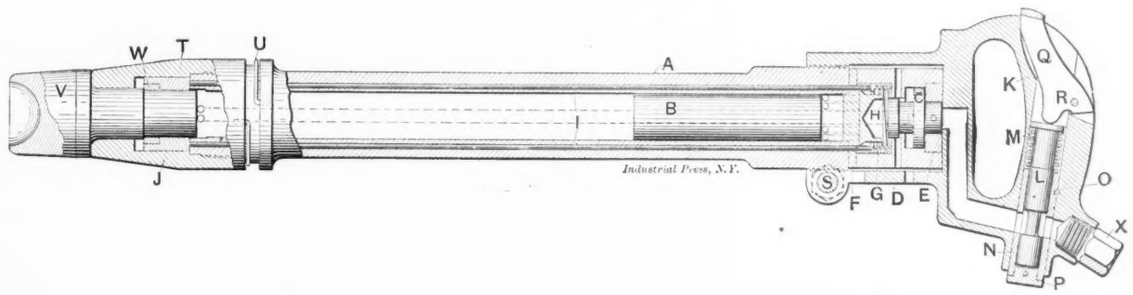
New Type Oil Cups.

THE KELLER PNEUMATIC RIVETING HAMMER.

The Keller pneumatic riveting hammer shown here in two views is made in three sizes by the Philadelphia Pneumatic Tool Co., Philadelphia, Pa. The smallest size, No. 6, has a capacity for hot rivets up to and including ¾ inch and requires 16 cubic feet of free air per minute compressed to a working pressure of from 85 to 110 pounds per square inch. The two larger sizes, Nos. 9 and 9x, have a capacity for hot rivets of 1 inch

Exterior View of Keller Pneumatic Hammer.

and 1¼ inches and require 18 cubic feet and 22½ cubic feet of free air per minute, respectively. The air pressure should be about 100 pounds per square inch, the limits of the working pressure of these tools also being 85 and 110 pounds. To get good, tight riveting with any pneumatic riveter we are informed that the rivets should be heated as hot as practicable the entire length. A pneumatic holder-on or any other good dolly-bar should be used to back the rivets up solidly. If these precautions are observed the best possible results may be obtained with these convenient tools.



Sectional View of Keller Pneumatic Hammer made by Philadelphia Pneumatic Tool Co.

In the sectional cut *A* is the cylinder; *B*, the reciprocating hammer; *C*, the main valve; *D*, the valve box; *E*, the valve box top; *F*, the valve box bottom. The main valve *C* moves longitudinally in the hammer barrel in the same direction as the hammer piston and at the same time instead of in the opposite direction, as is the case in some pneumatic hammers. Consequently, the impact of the blow instead of tending to jar the valve from its seat, tends on the contrary to seat it more firmly. *G* is the stop valve which is controlled by the position of the button-set *V*. When the button-set is not against a rivet the pressure of the coil spring *H* forces the stop valve *G* forward so that no air can enter the cylinder. When the button-set is pressed against a rivet it is moved backward, which movement is communicated to the stop valve ring *J*, which in turn forces the stop valve rods *I* back against the stop valve *G*, opening it against the pressure of the spring. *W* is a clamp for preventing the button-set dropping out of the stop valve ring *J*, when in use. *L* is the throttle valve shown in open position, being pressed downward by the finger lever *Q*. The throttle valve works in a bushing *N*, which may be renewed when worn by removing the bush plug *P* and the pin *O*. In all three sizes the handle *K* is screwed onto the cylinder barrel and locked fast by the clamp bolt *S*, which construction makes a simple and efficient fastening. The nose piece *T* is also screwed on the barrel and locked by the lock spring *U*. The ports and air passages in the cylinder barrel, are indicated by the small circles and dotted lines.

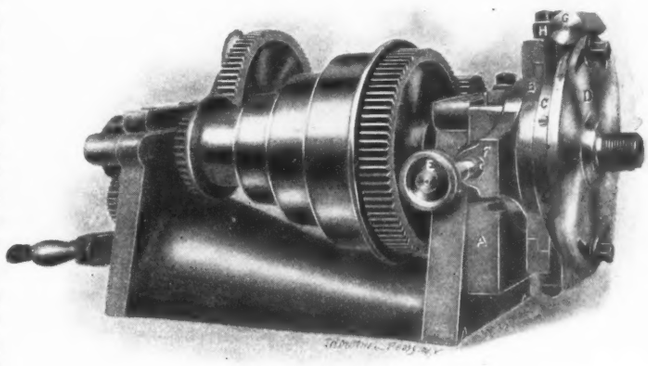
GEOMETRIC CHUCK.

For several years Gould & Eberhardt, Newark, N. J., have made to order a chuck for turning elliptical shapes, in an ordinary engine lathe. So many calls have been made for these chucks within the past year by manufacturers of electrical goods, die-sinkers, etc., that they have decided to place it on the market as one of their regularly manufactured products. The device, known as a geometric chuck, is shown in Fig. 1 attached to the headstock of an engine lathe. The part *A* is bolted to the face of the headstock. It has an opening for the nose of the lathe spindle and is horizontally grooved for a tongue on the piece *F*. The disk *C* is threaded to screw onto the lathe spindle and acts as a driver for the two slides *B* and *H*, which are mounted at right angles to each other. The center lines of these slides coincide with the axes of the elliptical motion of the disk *D*. The part *F* controls the movement of the slides to and fro from the center by means of a ring turned on its outer face and fitted into a circular groove in the back of the slide *B*. When *F* is moved over against a stop, the ring referred to is concentric with the lathe spindle; consequently the disk *D* has no elliptical movement so the work is turned circular. By shifting *F* from the center by means of two milled-head screws, one of which is shown at *E*, any desired ellipticity within limits, is obtained. It will be noted that the disk *D* carries a threaded nose. This is used for a regular lathe chuck or faceplate for holding the work. The disk is slotted and two screws are engaged in the slots to hold it in position. A worm *G* is provided which meshes in teeth cut in its periphery, by means of which the disk may be slightly shifted. The use of this is to bring work back to its original position when for any purpose it has been removed from the chuck. By loosening the clamping screws and shifting the disk by the worm, the work may easily be made to exactly coincide with its former position.

* * *

CYLINDER DOUBLE PORT-BORING MACHINE.

The large double port-boring machine shown in the cut, is made by the Grant Tool Company, Franklin, Pa., for simultaneously boring two ports in Corliss engine cylinders. It is a tool that has been carefully designed for the purpose, and

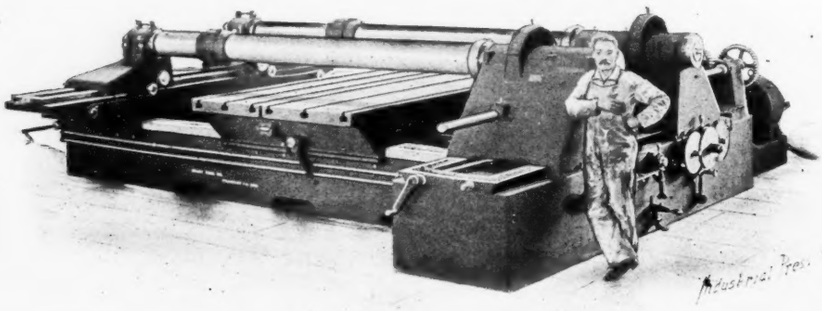


Gould & Eberhardt Geometric Chuck Attached to Engine Lathe.

is in use by a number of firms, with very satisfactory results. Two of the machines, one with 8-foot centers and the other 5-foot centers were recently built for the E. P. Allis Co., Milwaukee, Wis.

The machine illustrated bores ports from 15 inches to 8 feet apart and 8 to 18 inches in diameter, using traveling heads on the boring bars. Smaller ports are bored by traveling the tables relative to the cutter bars. The spindle heads have a

movement on the bed at right angles to the tables. The spindles are of hammered steel 7 inches diameter and 12 inches diameter at the front ends where radial keys are provided for driving the bars. The bars usually furnished with the machine are 5, 7 and 9 inches diameter and 7, 9 and 13 feet in length. The spindles have No. 6 Morse taper holes for centers, which size may be varied to suit individual requirements. The outer ends of the boring bars are supported by adjustable foot-blocks carrying adjustable sleeves so that the boring bars may always be closely fitted. The foot-blocks are fitted with bearings bored with No. 6 Morse taper holes the same as the head-blocks so the smaller boring bars may be carried on centers. The boring bar cutter heads are made in two parts held together by two swinging bolts. When the heads are removed the feed nuts are left in the bars, which construction makes the changing of cutter heads a simple and quick operation, as they have only to be slipped on and locked in position by the swinging bolts. The spindles are geared 60 to 1, and the feed of the bars may be varied from 0 to ½ inch in either direction. All feeds are driven by Sellers friction disks of a new and improved pattern. The table feeds may be varied from 3-64 inch to 1⅛ inches per spindle revolution. The tables have a quick return of 15½ feet per minute in either direction. They are respectively 3 feet wide and 6 feet 6 inches long, and 2 feet 6 inches wide and 6 feet 6 inches long. They may be used either independently or coupled together. The tables may be quickly coupled and are so used more especially for the adjustment when ports are being bored in very large cylinders. When ports are being bored in very small cylinders, the independent table may be lifted off.



Grant Cylinder Double Port-boring Machine.

The machine is adapted for either belt driving or electric driving. In case it is electrically driven any make of motor will be fitted at the option of the purchaser. The weight of the machine complete is about 47,585 pounds.

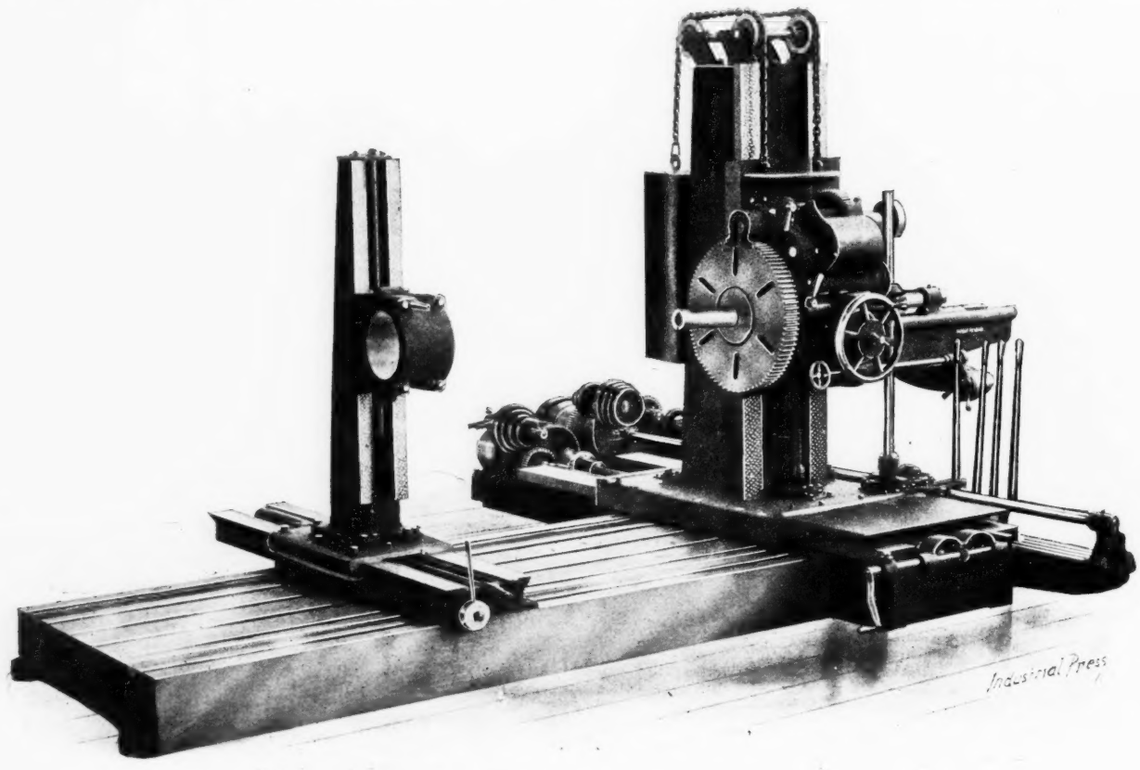
* * *

HORIZONTAL SPINDLE BORING MACHINE.

We illustrate herewith a horizontal spindle boring machine recently brought out by the Beaman & Smith Co., Providence, R. I. This machine is a comparatively new type and is built to operate on light or heavy work.

The column, which is mounted on a substantial bed, has a horizontal movement of 60 inches, and the head on the column, a vertical movement of 38 inches. It is therefore possible to place the center of the spindle so as to correspond with any point on a surface 60 inches wide and 38 inches high and from 24 to 62 inches above the top of the platen. The platen is 5 feet wide and 9 feet 6 inches long. The spindle is 4 inches in diameter, has a 32 inch movement by hand or power, is driven by a 3½ inch belt on a four-step cone, through gearing giving sixteen changes of speeds from 2 to 150 R.P.M., and suitable for work from ½ inch to 40 inches diameter.

The column, and also the head on same, are each provided with power movements, quick for adjustment and slow for feeds. To secure accurate alignment of the spindle and outer support for boring bar, four steel rules with pointers are suitably placed.



Beaman & Smith Horizontal Spindle Boring Machine.

Without removing the work, when once it is fastened the various operations of drilling, boring and tapping, and in many cases milling, can be performed at any point within the range covered by the horizontal movement of the column

and the vertical movement of the head on the column. This is an advantage, if the piece operated on be a heavy one, that can hardly be over-estimated, and is a feature that should commend the machine to the consideration of those who are intending to make a selection of machine tools for shop equipment.

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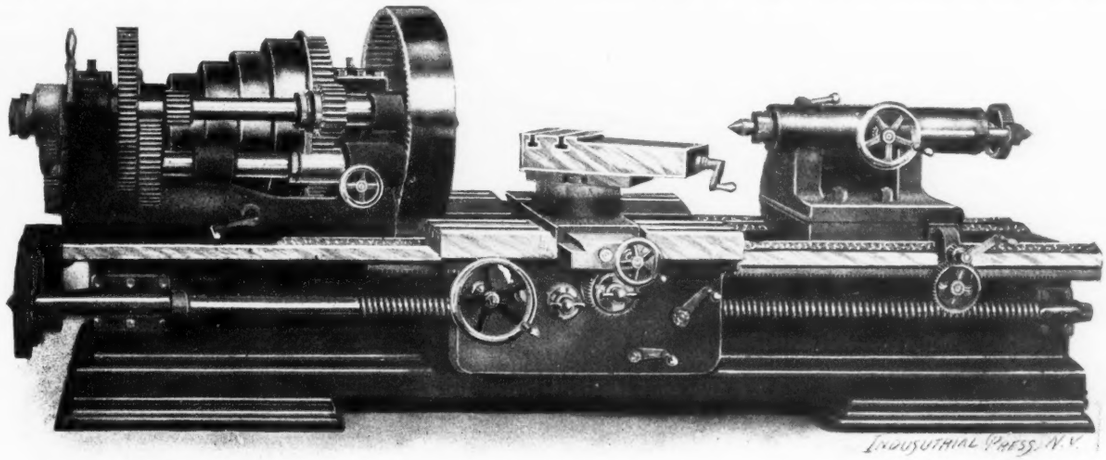
DAVIS FORTY-TWO INCH ENGINE LATHE.

The cut herewith illustrates a 42-inch engine lathe recently designed and built by the W. P. Davis Machine Co., Rochester,



W. P. Davis 42-inch Engine Lathe.

N. Y. It was designed to fill a demand for a strictly high grade, powerful engine lathe, to sell at a nominal price.

It has a driving power of 68 to 1; can be used with direct belt drive; with back gear, or triple gear. The cone has five steps, making fifteen changes of single speed. The compound rest has power feed in every direction.

The tailstock is of the cut-away pattern or what is known as the German pattern. The feed is reversed in the apron and can be changed instantly. Four changes of feed can be made by a lever on the front of the headstock, and the change can be made when the lathe is cutting a heavy chip, a feature that will be appreciated. A very heavy or a light chip can be taken, at the will of the operator.

For thread cutting, any change can be made in one minute. The spindle has an end thrust bearing directly on the end of the spindle. The large cone is 24 inches in diameter and takes a five-inch belt. The carriage is so arranged that the compound rest can be fed out seven inches beyond the face of the carriage, thus getting full benefit of the full swing of the lathe. The lathe, as shown, weighs with 16 foot bed, about 19,000 pounds.

* * *

GLEASON AUTOMATIC CUTTER AND REAMER GRINDER.

An automatic cutter and reamer grinder is shown in the accompanying illustrations, Figs. 1 and 2. The machine gives the cutter or reamer both a longitudinal and rotary motion, the latter being accomplished by a pawl which engages each tooth in succession; and as the wheel grinds only the blade or tooth engaged by the pawl at the time, irregularly spaced reamers may be ground. There is also provision for grinding spiral reamers and cutters, end mills, angle mills, etc. So far as we know the application of the automatic principle to cutter and reamer grinding is entirely new and it must effect a considerable time saving in the tool room.

The mechanism of the moving parts of the machine is simply arranged. The carriage which carries the cutter or reamer slides upon ways made to pivot about a vertical spindle, supported by an overhanging arm. The countershaft at the base of the machine is driven by belt from any overhead shaft and carries pulleys for driving the wheel arbor and also wheel *A*, which latter gives a reciprocating motion to a rack and pinion at *D*, through a worm and wormwheel encased at *B* and the pitman *C*. The vertical shaft on which pinion *D* is located has a worm gear at the top which engages a screw rack attached to the carriage and clearly indicated in Fig. 2. This form of rack is used so that the position of the cutter may be changed with respect to the wheel while the machine is in motion, and it also serves the purpose of a hand feed motion for the carriage.

In Fig. 2 the machine is shown adjusted for plain, straight reamers with the pawl in position to engage the reamer teeth in succession. The pawl is operated by the reciprocating motion of the carriage. At the bottom of the pawl socket is a roller which comes in contact with an adjustable inclined bar at each traverse of the carriage in one direction and operates the pawl. Each tooth thus passes under the wheel twice before spacing occurs.

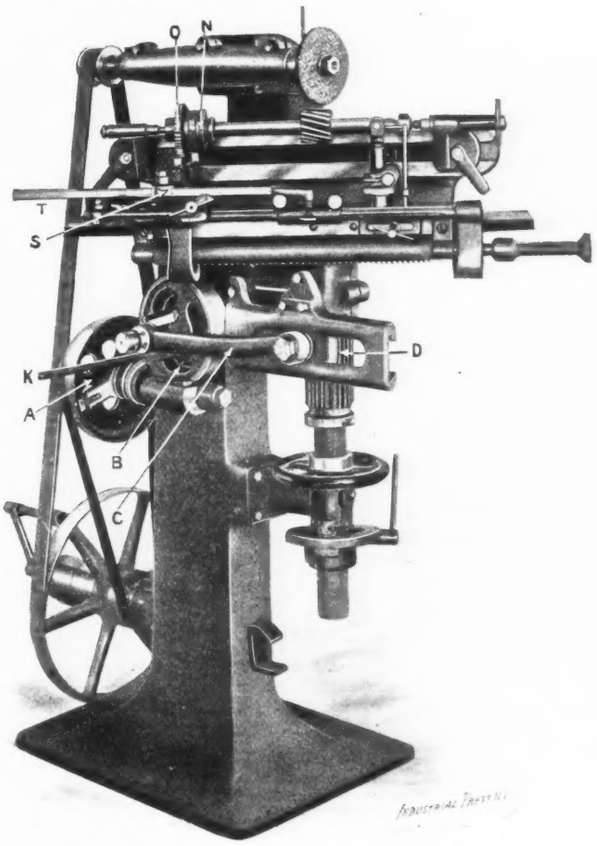


Fig. 1. Gleason Automatic Cutter and Reamer Grinder.

In grinding spiral cutters the carriage is swung around to bring the wheel normal to the cutter teeth. The pawl feeds the teeth as before and the cutter is given a spiral rotary motion in addition. Provision is made for tripping the feed

pawl when not spacing, if the angle of spiral is great enough to cause interference when the cutter is moved back and forth. In Fig. 1 the machine is shown with a spiral cutter in place, the pawl being moved to one side, to give a better view. The spiral motion is given to the cutter by the mechanism at the left of the carriage. The cutter arbor is fitted to a sleeve, *N*, and on this is a segment *O*, which is made to oscillate by means of a sliding block *S*, which slides on the bar *T* when the carriage moves. Sliding block *S* is attached to a rack which meshes with segment *O*. The latter has a frictional connection with the cutter arbor. The amount of oscillation given to the segment is gaged by the inclination of the bar *T*, which can be adjusted accurately by means of a wormwheel and tangent screw. The frictional contact of the segment is sufficient to hold the cutter in position or to turn it, but in

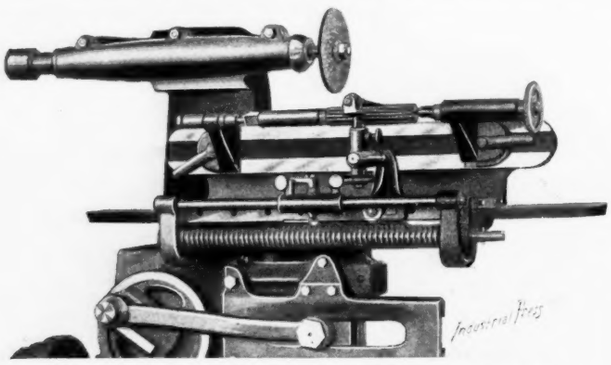


Fig. 2. Grinder Adjusted for Plain Straight Reamer Grinding.

feeding or rotating for another tooth the pawl overcomes this friction. For grinding face or bevel cutters, or other shapes, a special head is provided which can be placed in position quickly.

The amount of travel of the carriage is regulated by adjusting the position of the crankpin which operates the pitman; and for different lengths of cutters three speeds of travel for the carriage are provided, controlled by the clutch lever *K*.

Due provision is made for lubricating all working parts, oil holes being fitted with dust-proof oil cups. The spindle box has an oil chamber, protected from dust. All the working parts on the central column or screw are lubricated from one oil chamber. The countershaft at the base has tight and loose pulleys and the loose pulley is self oiling. The countershaft can be belted directly from an overhead shaft.

This machine is manufactured by the F. Gleason Machine Works, Olney, Philadelphia.

* * *

AUTOMATIC ENGINE LATHE.

In the notes on the new shops of the Skinner Chuck Co., published in the March issue, mention was made of a simple automatic engine lathe used in that shop for threading chuck jaw screws. We understand that the firm building this lathe, the Automatic Machine Co., Bridgeport, Conn., are now prepared to furnish these machines to the general trade. This machine cuts screws of any length and diameter up to the capacity of the machine in the same manner as done in an ordinary engine lathe, but automatically. As mentioned in the article referred to, about all the attention required of the operator is to dog the work, put it on the centers and start the machine. When the thread has been finished by repeated passes of an ordinary threading tool held in two opposing tool-posts, the machine automatically stops and awaits the removal of a finished screw and the insertion of another blank. The thread is cut by two tools, one on each side of the work so the threads are smoothly finished, there being little or no tendency for the work to mount the tools or to chatter, since the upward thrust of the front tool is balanced by the downward thrust of the rear tool. The guaranteed time for cutting a U. S. standard pitch screw 2 inches diameter and 12 inches long, is twenty-four minutes; a 1-inch screw of the same length is cut in twelve minutes and other diameters and lengths in proportional time. The lathe is not confined to cutting external screws, but is equally well adapted to internal threading. It is also well adapted to cutting "quick" pitches and multiple threads either external or internal.

* * *

In a catalogue issued by the Adams Company is given a receipt for an amalgam said to be useful for stopping holes that cannot be readily soldered. An alloy is first made of zinc and tin in the proportion of 66 per cent zinc and 34 per cent tin. The alloy is reduced to a finely divided state by filing or otherwise. Mercury is mixed with the filings and kneaded by the hands into a stiff dough from which all the mercury possible is squeezed out. The amalgam thus made is pressed into the cavity to be filled and left to harden. When hard it can be filed and scraped the same as the metal itself.

* * *

It seems difficult to believe that anthracite coal has been used for fuel only one hundred years, but such is the case. On February 11, 1902, the one hundredth anniversary of the first burning of "black rock," as anthracite coal was then called, was celebrated at Wilkesbarre, Pa.

* * *

PERSONAL.

MR. EDWARD C. DEWOLFE, late in charge of the drafting room of the Dodge Mfg. Co, Mishawaka, Ind., and a contributor to the columns of various mechanical journals, has accepted a position as associate editor of *Steam Engineering*, which has lately removed from New York to Chicago. He takes up his new duties at once.

MR. CLARENCE P. DAY, formerly connected with MACHINERY, and now advertising counsellor, with an office at 140 Nassau St., New York, announces that he has now an "Advertising Shop," which is in charge of an experienced advertising editor and designer, assisted by artists, all of whom have had a machine shop experience. He is prepared to produce good original "ads," booklets, folders, bulletins and catalogues representing the business, objects and purposes of his patrons.

FRESH FROM THE PRESS.

THE IRON AGE DIRECTORY: A Classified Index of Goods Manufactured by Advertisers in the *Iron Age*. Published by David Williams Co., 232 William St., New York. Price, 25 cents.

According to the announcement contained in this directory 1,356 business firms and manufacturers of 4,749 different tools are advertised in the *Iron Age*. As such a list is necessarily a quite complete representation of the firms and products in its field, it has been thought best to issue a classified index of these firms and products in a somewhat more complete form than is feasible in the weekly and monthly issues of that journal. A copy is sent to each subscriber, and others can procure a copy by sending the price mentioned.

EASY LESSONS IN MACHINE DRAWING AND DESIGN. By J. G. A. Meyer and Charles G. Peker. Parts 19 and 20. Price, 50 cents each. Also Volume II. of the same work comprising Parts 13 to 20, handsomely bound in green cloth with gilt title. Price, $4. Price of Volume I. bound in same style and containing Parts 1 to 12, inclusive, $6. Published by the Industrial Publication Co., 16 Thomas St., New York.

As most of the old subscribers of MACHINERY probably remember, this excellent work has been issued in parts at intervals during the past five years. The first two parts, Nos. 1 and 2, were reviewed in the May, 1897, issue, and at that time it was expected that twenty-four parts would be issued in all. The death of Mr. Meyer before the completion of the publication of the work made it advisable to somewhat curtail the number of parts. This, however, might have been the case in any event, as the number of parts required to properly cover the subjects was undoubtedly largely a matter of estimate. The remainder of the work has been ably edited by Mr. Charles G. Peker, and its publication is completed with Part 20. In the various reviews of the parts as they have been issued we have had only words of commendation. Now that the work is complete we can only reiterate what has been said before. The two volumes should make a most welcome and valuable addition to the working library of almost any mechanic, draftsman, or even the mechanical engineer. The illustrations are the best, being fine examples of the draftsman's and engraver's arts. The descriptive matter is couched in language expressive and simple, and directly to the point. The mathematical calculations have uniformly been made so clear and simple that anyone having knowledge of ordinary arithmetic and elementary algebra can readily follow them through. The work is one essentially for home study and is designed for the working man of limited education who has an ambition to better his condition in life. From it he can get a first-class course of instruction in mechanical drawing and machine design. Geometrical drawing is first taken up and then followed by mechanical drawing, development of surfaces, laying out boiler work, construction of gears, laying out gear teeth for spur and bevel gears, general machine design, including machine tools, engines, machine details, etc.; also mensuration, applied mechanics, strength of materials, valuable data on bolt and pipe threads and similar subjects arranged for convenient reference. Part 20 contains a portrait of Mr. Meyer, and a frontispiece in colors showing the conventional colors sometimes used to represent cast iron, steel, brass, brick, wood, leather, etc. It also contains an insert giving examples of brush shading as employed in wash drawings.

ADVERTISING LITERATURE.

SCHWENCKE, KIRK & CO., New York. 6 by 9 illustrated catalogue and price list of drawing instruments produced by this company.

THE PRATT & WHITNEY CO., Hartford, Conn. Advertising card illustrating the company's patent process taps.

THE AURORA TOOL WORKS, Aurora, Ind. Catalogue No. 7 of upright and radial drills and of milling machines. Their upright drills are made in 20 sizes and styles.

THE BOSTON GEAR WORKS, Boston, Mass. Supplementary catalogue of "Boston" bevel and spur compensating gears, chains, sprockets, rawhide and fiber gears, tool steel balls, worm hobs, cutters, etc.

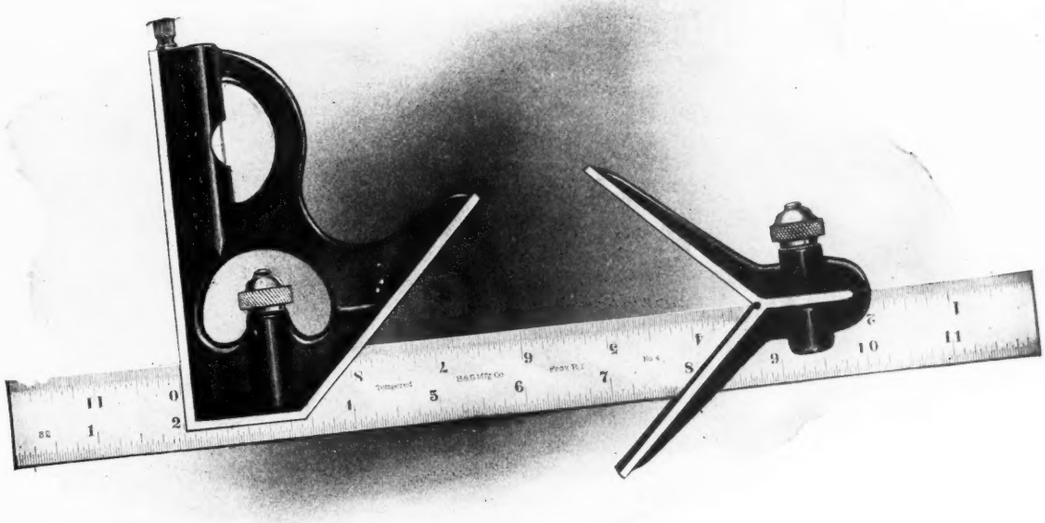
THE BICKFORD DRILL AND TOOL CO., Cincinnati, O. Illustrated booklet entitled "Fifty-six Points of Vantage," which is a summary of the principal features embodied in the new Bickford radial drill, illustrated elsewhere in this journal.

Brown & Sharpe Mfg. Co.

Providence, Rhode Island, U. S. A.

COMBINATION SQUARES

MADE ON MECHANICAL LINES.



Distinctive Features:—

HEADS—Steel, Drop Forged; Furnished Either Soft or Hardened.

BLADES—Accurately Graduated, Shaded Figures, Furnished Either Soft or Tempered.

CLAMPING GROOVE, ROUND—Allows Heads to be quickly Clamped, Forces Blade against side of Slot Square with Face of Head, Admits of Stronger Blade and clamping bolts than does the usual square groove, No Sharp Corners to Collect Dirt.

HARDENED HEADS AND TEMPERED BLADES.

Our Tools carried in stock by all Leading Hardware and Supply Dealers.

CATALOGUE MAILED TO ANY ADDRESS UPON APPLICATION.

THE NEW PROCESS RAW HIDE CO., Syracuse, N. Y. Catalogue, pocket size, of pinions, with very complete price list. The catalogue also contains a page list of some of the prominent users of the New Process pinions.

PAWLING & HARNISCHFEGER, Milwaukee, Wis. Bulletin No. 10 of the company's chain block traveling cranes and standard I-beam trolleys. This apparatus is but an adjunct to this company's line of electric traveling cranes and traveling electric hoists.

THE ROCHESTER ELECTRIC MOTOR CO., Rochester, N. Y. Bulletin No. 55 of the type "C" direct-current factory motors and small generators. This gives a description of these motors and of their various parts, with illustrations.

THE AMERICAN TOOL WORKS CO., Cincinnati, O. Leaflet calling attention to the company's 30-inch pulley turning lathe, with a table showing the number and size of pulleys that can be turned in this lathe in ten hours with proper handling.

A BEAUTIFUL colored bird's-eye view of Long Island has been received from the passenger department of the Long Island R. R. The map or view shows the topographical features of this garden spot of America from East River to Montauk Point. Sent to any address for 6 cents postage.

J. GEO. LEYNER, Denver, Colo. 1902 catalogue B, of Leyner air compressors actuated by water power, electricity, belting or steam, with tables giving the efficiencies and capacities of the compressors at various altitudes. The Leyner air receivers, rock drills and air reheater are also shown.

THE UNIFORM STEEL CO., Newark, N. J. Pamphlets entitled "What We Do," telling of a secret process owned and used by this company in the manufacture of cutting, stamping, pipe threading dies, etc. The company state that with this process they make steel tools equal to the best forged steel, without forging.

THE HYATT ROLLER-BEARING CO., Harrison, N. J. Bulletins Nos. 23 and 24 of the Hyatt flexible roller bushings as applied to loose pulleys. Bulletin No. 23 contains a report of the Franklin Institute of Philadelphia on a series of tests made on the Hyatt flexible roller, with the favorable conclusion arrived at by the committee.

THE THURSTON MFG. CO., Providence, R. I. Folder, fully illustrating the Thurston die milling machine and filing machine. Also their swaging or reducing machine and internal sensitive grinder. A price list of the saws they manufacture for use on brass, German silver, copper, horn, aluminum, etc., is also given.

THE BUFFALO FORGE CO., Buffalo, N. Y. Booklet, fully illustrated, describing the ventilators manufactured. These are built in various types and sizes, of heavy gage steel, and the company state that they resist any strain of reasonable magnitude to which they may be subjected. The company will be pleased to furnish this booklet to anyone interested.

BEMENT, MILES & CO., a branch of the Niles-Bement-Pond Co., Philadelphia, Pa. Handsomely illustrated catalogue of steam hammers. These include single and double frame steam hammers, open frame steam hammers, double frame steel tilting hammers, and drop hammers, with general instructions as to their erection, starting and maintenance.

THE ALBERGER CO., Buffalo, N. Y. Illustrated pamphlet descriptive of the Buffalo tandem gas engines manufactured by this company. The construction and operation of this gas engine are treated, its special features dealt with and its different parts thoroughly described and illustrated. The Buffalo gas engines are built in many sizes, making a complete range from 30 to 500 H. P.

THE AUTOMOBILE AND CYCLE PARTS CO., Cleveland, O. Three pamphlets showing the various forms of balls manufactured by them. These include high-duty tool steel balls, standard tool steel and Bessemer balls, and brass and bell metal balls. Various sizes of these are carried in stock, and the makers state that their aim is to make these balls of stock which at the outset is certain to work well and can be hardened and ground and converted into practically perfect spheres.

THE NEWTON MACHINE TOOL WORKS, Philadelphia, Pa. Catalogue No. 34 of machinery for army, navy, railway and general machine shop equipment. This catalogue is bound in cloth and contains 188 pages of matter descriptive of the machines manufactured by this company. Also a complete alphabetical index. The catalogue is profusely illustrated and every possible information regarding the products of the company will be found therein

THE ROOT & VAN DERVOORT ENGINEERING CO., East Moline, Ill. Illustrated catalogue of the "R. & V." gas and gasoline engines. These include horizontal gas engines, direct-connected lighting engines, portable gasoline engines and vertical engines. The "Reindeer" gasoline engine and the "R. & V." duplex power pump are also shown. The company also offer a first class equipment of gas engine accessories.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., have sent us circulars announcing that the management of the School and that of the Armour Institute of Technology have recently decided to co-operate in providing technical education by correspondence. The professors of the Institute are now associated with the faculty of the American School and credits obtained in the American School will count toward a degree at the Armour Institute. Further information concerning this will be sent upon request.

MANUFACTURERS' NOTES.

THE UNIFORM STEEL CO., manufacturers of steel castings, 451 Riverside Ave., Newark, N. J., are erecting a new plant, which will be ready for occupancy in about six weeks.

THE FAIRBANKS CO., formerly at 311 Broadway, New York, have removed to 416-422 Broome St., where they have a spacious establishment.

SPON & CHAMBERLAIN, publishers of engineering and technical books, have moved from 12 Cortlandt St., New York, to the Liberty Building, 123 Liberty St., New York

THE MUTUAL MACHINE CO., 25 Wells St., Hartford, Conn., is a new concern organized for the manufacture of universal joints and tool posts. Messrs. Warren and Faxon are the proprietors.

THE WILMARTH & MORMAN CO., Grand Rapids, Mich., state that their shipments in April of this year were about 40 per cent greater than those of April of 1901.

THE FOSTER ENGINEERING CO., Newark, N. J., have received an order from the Grand Trunk Railroad for 75 railway steam heating valves to be used in connection with new work.

A. G. BUTLER, 101 Beekman St., New York, manufacturer of pattern letters for iron and brass castings, has removed to the Commonwealth Building, 284 Pearl St., New York.

THE AMERICAN BLOWER CO., Detroit, Mich., have received from the Lestershire Mfg. Co., Endicott, N. Y., where they installed their A. B. C. fan system of heating, a letter stating that the apparatus is giving them most satisfactory results.

THE JACKSON MFG. CO., Reading, Pa., manufacturers of small machinists' tools, has been absorbed by the Reading Standard Mfg. Co., of Reading, Pa. This company has just issued a very attractive circular, of which we have received a copy.

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THE PHILADELPHIA PNEUMATIC TOOL CO., Philadelphia, announce that they are preparing for a display of their tools in a working exhibit which will take place at the Convention of Master Mechanics and Master Car Builders, at Saratoga, from June 18 to 25.

THE FOX MACHINE CO., Grand Rapids, Mich., announce that they have recently organized the Fox Typewriter Co., Ltd., with $1,000,000 capital, for the manufacture of the Fox typewriter. This will enable the Fox Machine Co. to devote itself entirely to the sale of the patented articles which it manufactures.

THE firm of Kraeuter & Co., at 577 18th Ave., Newark, N. J., who have for a number of years been the manufacturers of machinists' small tools, has recently been reorganized, and while the firm name is not to be changed, Mr. Arthur Kraeuter is the present manager. They will continue to manufacture machinists' tools, and have added a line of patent belt punches.

THE HYATT ROLLER BEARING CO., Harrison, N. J., are to erect a new shop on the property adjoining their present plant. The building will be 50 by 200, two stories high. The company state that the demand for their bearings has been so great that they have outgrown their present facilities. Other improvements are also being contemplated.

THE CLING-SURFACE MFG. CO., Buffalo, N. Y., have sent us copies of three letters they received, one from the H. K. Porter Co., Pittsburgh, Pa., the others from the Cuyahoga Steel and Wire Co., Cuyahoga Falls, O., and from the Wellington Machine Co., Wellington, O., indorsing Cling-Surface and stating that they have had most satisfactory results from its use.

THE BUFFALO FORGE CO., Buffalo, N. Y., report a brisk demand for their products. They recently equipped the forge shop of the Pennsylvania Steel Co. with 20 Buffalo down-draft forges. They have also installed three large fan system heating plants at the Lake Shore & Michigan Southern R. R. shops, and will furnish a 200 H. P. horizontal center crank engine for the electric lighting plant at the Bowery Bay Building and Improvement Co.

THE DRESES MACHINE TOOL CO., Cincinnati, O., announce that by mutual consent Mr. Oscar W. Mueller has withdrawn from the firm of Dreses,, Mueller & Co., and his interest has been acquired by the former co-partners—Messrs. Henry Dreses, Wm. Gilbert and Chas. Lange. The name of the company has been changed from Dreses, Mueller & Co. to the Dreses Machine Tool Co. The management of the firm will be, as heretofore, under the supervision of Mr. Henry Dreses.

THE BUFFALO FORGE CO., Buffalo, N .Y., have recently received an order from the Sauquoit Silk Mfg. Co. for eight of their high-speed automatic engines which will be used in their works at Scranton, Philadelphia and Bethlehem, Pa. These will be of the enclosed type, running in oil, which thus presents no difficulties in the way of damage to goods by throwing oil on them. The engines will be used principally as auxiliaries in the case of breakdowns to the main engines, so that the separate sections of the mills may be kept running without loss of time.

THE H. W. CALDWELL & SON CO., Chicago, Ill., have recently purchased the entire equipment of gear patterns, molding machinery, gear cutters and all other appliances pertaining to the business of the Walker Mfg. Co., of Cleveland, O. The Walker gears have for many years sustained a reputation for excellence and correctness of design, and the Walker pattern list is probably the most complete in existence. The Caldwell Co. state that they are prepared to furnish gears from the Walker patterns promptly, and that they will maintain the high standard established for these gears by the Walker Co.

THE PHILADELPHIA PNEUMATIC TOOL CO., Philadelphia, Pa., inform us that they have ordered $10,000 worth of new machine tools to be delivered to them in June for their new shops at 21st St. and Allegheny Ave.; and 150 men will be required hereafter instead of the 95 at present employed. They have recently placed on the market two new sizes of rotary drills and have also perfected an improved riveting hammer, which is being made in three sizes. The company report a rush of business. They recently received orders aggregating nearly 200 tools from one of the large shipyards of the country and have had a lot of railroad and other trade.